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PREFACE

Special education and rehabilitation uses the knowledge of various scientific disciplines in order to understand and solve the problems of persons with permanent developmental and / or acquired impairments and disorders. This indicates a need for an interdisciplinary analysis of many studies in order to obtain systematic knowledge.

This publication presents the results of up-to-date research in various scientific disciplines, which may have theoretical and / or practical application in special education and rehabilitation. Each paper is based on previous research and is the basis for reanalysis and comparison of different research on the same problem. The implicit application of the principle of support is observed, because many researches support each other in order to form a general conclusion. The ultimate goal is cumulative knowledge, assuming that more can be learned from the data as a whole than from individual parts, i.e. individual papers.

A multidisciplinary and multidimensional approach is the basis for structuring this publication. The papers are grouped into several thematic areas that represent a single functional unit. At the same time, certain papers belong to a group of research based on the study of bio-psycho-social potential and its disposition for special education and rehabilitation, while another group of papers belong to applied research based on experimental models that proved conditions, procedures, methods and techniques, by which a person with permanent developmental and / or acquired impairments and disorders can be educated or rehabilitated. In general, research interests are oriented in the direction of disturbed composition of bio-psycho-social potential and its action in certain conditions. From the methodological aspect, it practically means the study of connections, relationships and conditions in which one phenomenon acts affirmatively, i.e., in which it has a tendency to be undesirable. In these cases, quite specific scientific problems are considered in the range from those that are focused in the domain of the narrow specialty of one disorder or impairment, to those that involve a combination of two or more disorders or impairments. We should also emphasize the research related to the study of the model of special education and rehabilitation throughout history, which thus provides insight into the sequential cross-sections in the development of science (special education and rehabilitation), but also the wider social context in which it operated.

Contemporary research trends about persons with permanent developmental and / or acquired impairments and disorders in various scientific disciplines, discreetly abandon the view that disabilities are studied in the context of deviations from the typical and meet the decades-old doctrinal views of special education and rehabilitation. They primarily imply an intervention that will lead to the improvement of personal (educational, professional, social and adaptive) potentials in persons with permanent developmental and / or acquired impairments and disorders, slowing down and eliminating undesirable patterns of motor, cognitive and social behavior. The support in all this lies in the remaining abilities, but also in the stimulation and development of those agents that are not defined by the primary damage or disorder. The analysis of the presented papers can show: inconsistencies in the samples of participants (some are not sufficiently representative of the hypothetical population); inconsistency of measuring instruments both in terms of number and applied measuring procedures; inadequacy of research models for the purpose and goal of research, as well as the application of inadequate statistical procedures; very few studies of longitudinal and experimental character. However, it is encouraging that a high level of research quality is observed both in technology and in the construction of research models. The application of modern technology and methodology, the application of adequate measuring instruments as well as their standardization enable a more complete understanding of the bio-psycho-social status of persons with permanent developmental and / or acquired impairments and disorders, and makes the results of researches by various researchers comparative.

Finally, the general conclusion is that we know a lot about persons with permanent developmental and / or acquired impairments and disorders today, but we still have few practical solutions to their everyday problems. Researches from abroad are good for comparative and methodological purposes, but do not have significant practical application in our system of special education and rehabilitation. A common feature is complex, integral and multidisciplinary rehabilitation and education. Treatment, rehabilitation and social protection of persons with disabilities represent minimum standards. The difference between what is happening in the conceptual sense in the world and in our country, is a consequence of the difference in doctrinal attitudes and cannot be justified by the lack of funds.

Experts from relevant fields participated in the conception and writing of this publication.

Thank you all for your immeasurable contribution!

Editors

Theme 1

General topics

SERBIAN COGNITIVE RESERVE INDEX QUESTIONNAIRE: ADAPTATION AND VALIDATION

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SUMMARY

Cognitive reserve (CR) is defined as the ability to optimize or maximize usage of neural networks when facing tasks with greater cognitive load serving as a protective factor from cognitive decline. In clinical population, it is assumed that CR has the role of minimizing effects of brain pathology on cognitive functioning through more flexible alterations between engaged neural networks. In the earliest stages of construct development, it was predominately expressed via levels of education or verbal intelligence. However, accumulated research evidence suggested that CR is a multidimensional construct and that various lifelong activities should be taken into account when assessed. Following this line of studies, Cognitive Reserve Index questionnaire (CRIq) was developed providing a standardized procedure for measuring CR that includes years of formal and informal education, professional occupational background and engaging in various cognitively stimulating activities. The goal of this study was exploring the utility of Serbian translation and adaptation of CRIq using a sample of 117 (61% female) healthy adult participants with age ranged from 19 to 86 (M = 41.37, SD = 21.91). Study results suggested the same pattern of age differences as reported in previous studies, while gender differences were not detected. Testing correlations between CRIq scores and measures of cognitive functioning such as intelligence, verbal fluency, categorical fluency, and executive functions yielded significant results only for Education subscale and Intelligence and executive functions (CTT Form A). Future implications for CR assessment and practical utility of CRIq were offered.

Key words: Active models, Brain reserve, Cognitive reserve, Cognitive Reserve Index questionnaire

INTRODUCTION

Passive and active models of reserve

The introduction of brain and cognitive reserve into the field of neuropsychology came as a result of evidence that showed individuals with similar brain pathology differ in terms of cognitive functioning and the course of recovery (Katzman et al., 1989), and that cognitive performances are differentially affected by aging in healthy individuals. Brain reserve (Katzman, 1993; Satz, 1993), and cognitive reserve (CR; Stern, 2002, 2003, 2009) are presented as key constructs within passive and active models, respectively. Passive models describe these differences as a function of variations in innate brain characteristics such as brain size or synapse count. These differences provide different brain damage thresholds which, if exceeded, will result in functional impairment (Pinto & Yeshwant Tandel, 2016; Stern, 2002). Thus, brain reserve had been defined as “differences in brain size and other quantitative aspects of the brain that explain differential susceptibility to functional impairment in the presence of pathology or other neural insult” (Barulli & Stern, 2013, p. 502). Active models, on the other hand, describe active attempts of the human brain to overcome detrimental consequences of brain damage (Pinto & Yeshwant Tandel, 2016; Stern, 2001). Within this framework, CR has been defined as “the ability to optimize or maximize performance through differential recruitment of brain networks, which perhaps reflects the use of alternate cognitive strategies” (Stern, 2002, p. 451). In other words, CR reflects differences in cognitive processes that result from lifetime intellectual activities and different environmental factors (Barulli & Stern, 2013) and that can boost performance during increased task demands but also determines how much brain damage one can tolerate before impaired cognitive functioning becomes obvious. This moderating effect of CR has on the relationship between brain pathology/normal aging and cognitive functioning is depicted in Figure 1.

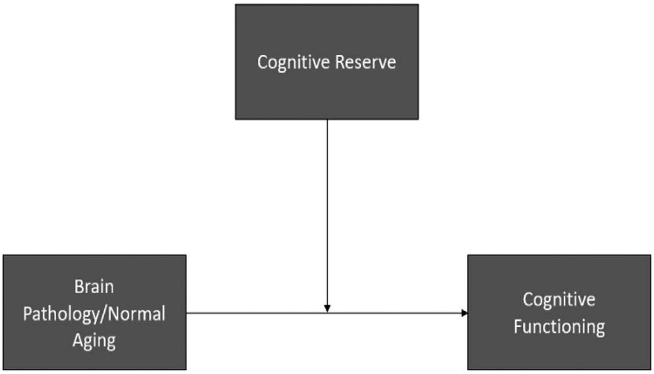

Figure 1. Moderating effect of Cognitive Reserve on the relationship between brain pathology/normal aging and cognitive functioning.

Given that CR is a cognitive construct, attempts were made towards finding the neural basis of CR (Barulli & Stern, 2013; Steffener & Stern, 2002; Stern et al., 2002). Barulli and Stern (2013) proposed its two potential neural bases – neural reserve and neural compensation. Former was related to the ability to optimize or maximize usage of cognitive networks in unimpaired people, and the latter to activation of new brain structures in impaired population - such structures that do not typically underly the particular cognitive activity in healthy individuals (Barulli & Stern, 2013; Stern, 2002). There are at least some indications that this might be the case and they come from functional imaging studies, where Stern (2002) noticed that there is a difference in way healthy individuals are coping with demanding cognitive tasks in comparison with impaired, clinical population. Thus, according to Stern (2002), CR’s impact on performance can be visible in healthy individuals engaged in any demanding cognitive task due to its requirement for greater network efficiency and does not necessarily require presence of the brain pathology. However, it has been assumed that compensation is always induced by a brain pathology. Although not usually distinguished in the literature, it is assumed that the distinction between neural reserve and compensation is crucial for correct interpretation of study results, especially when patients and healthy controls are compared to each other (Stern, 2002). Neural reserve (and CR studied in healthy individuals) should be viewed as a protective factor in case of an insult, and compensation reflects attempts to maintain or improve already affected cognitive functioning through activation of alternative neural networks and those with greater CR are more successful in it (Barulli & Stern, 2013).

Active models seem to be more optimistic in terms of practical interventions, suggesting that people's engagement in different activities over the course of life can provide them with greater CR. In other words, the idea of CR posits that different response patterns in face of brain damage depend on lifetime experiences such as education, occupation, and participation in cognitively stimulating leisure activities (e.g., scrabble, reading, playing chess; Opdebeeck, Martyr, & Clare, 2016). Therefore, active models suggest that underpinnings of CR are amenable to change potentially providing us with new guidelines for prevention and cognitive rehabilitation (Stern, 2012). However, it should be pointed out that passive and active models are not mutually exclusive, but rather reflective of parallel processes that could be described as "hardware" (physical) and "software" (functional) entities. Additionally, people with the same brain reserve can differ in levels of CR due to different life experiences (Barulli & Stern, 2013). Finally, it is plausible that a variety of activities involved in building CR can stimulate structural changes, suggesting that CR can affect brain reserve as well (Opdebeeck et al., 2016).

Proxies of cognitive reserve

As opposed to brain reserve, CR cannot be directly observed, and it is still not clear which particular aspects of human functioning should be considered as a good estimate of CR levels. Factors such as IQ, education, occupation, cognitively stimulating leisure activities, social stimulation, sleep, diet and hygiene seem to be the most promising indicators of CR (Pinto & Yeshwant Tandel, 2016), since they all appear to buffer symptoms of brain damage and serve as a protective factor against dementia (Blondell, Hammersley-Mather, & Veerman, 2014; Fratiglioni & Wang, 2007; Scarmeas, Levy, Tang, Manly, & Stern, 2001; Verghese et al., 2003). Yet, there is no consensus on how to operationally define these factors. Consequently, researchers have been choosing both, proxies of CR and instruments used to assess them, making comparison of study results difficult. In one meta-analysis published in 2019 (Kartschmit, Mikolajczyk, Schubert, & Lacruz, 2019) authors evaluated 37 papers and six different questionnaires and failed to single out any of them because their psychometric properties were poorly assessed, if assessed at all.

In most studies, only education was considered a CR proxy and even in that case there were differences in terms of the scale that was used to assess the education levels (e.g., numerical scale for the number of years of education vs. discrete scale for qualification). The results reported so far imply that higher education is negatively associated with a cognitive decline that occurs with aging (Pinto & Yeshwant Tandel, 2016), as well as with brain disorders (Nucci, Mapelli, & Mondini, 2011). However, there are some fluctuations in the results and strength of the relationship of higher education with both cognitive decline and brain disorders depending on the cognitive function that was used as an outcome (Opdebeck et al., 2016). In addition, differences in type and quality of education in different contexts could potentially confound the observed effects. A meta-analysis published by Opdebeeck et al., in 2016, found significant relationships between CR and the following cognitive domains: working memory, executive functions, visuospatial abilities, language, and overall cognitive functioning in healthy older people, although estimated effect sizes varied from small to medium. Furthermore, Roldan-Tapia and colleagues (Roland-Tapia et al., 2017) reported the same pattern of results suggesting that working memory, visuo-constructive abilities, and some executive functions are moderated by education.

Besides education, greater premorbid intelligence has been frequently shown as a protective factor for executive functions impairments among individuals infected with hepatitis C (Basso & Bornstein, 2000), which places it within the theoretical framework of CR. Measures such as Vocabulary subscale of the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1981) or National Adult Reading Test (NART; Nelson, 1982) are typically used to estimate premorbid levels of intelligence as a proxy of CR. However, some authors do not consider verbal IQ as an indicator of CR, but rather as a measure of cognition that should be defined in terms of the outcome (Opdebeck et al., 2016), which could potentially explain why education has been chosen more often as one of the components of CR over intelligence.

Stern and colleagues (Stern et al., 1994) addressed occupational attainment and Alzheimer's disease in a sample of non-demented old individuals. After following them for more than 4 years, they concluded that more skillful and educated people not only had a lower risk of developing dementia but also showed slower cognitive declines, championing the idea that occupational attainment can be considered as a potential building block of CR (Stern et al., 1994). Finally, negative associations between engaging in cognitively stimulating activities (e.g., physical activity, social, and individual types of leisure activities), cognitive decline (assessed in various ways), and dementia received support in previous studies, both cross-sectionally and longitudinally (for a systematical review see Wang, Xu, & Pei, 2012).

Most recent approach to measurement of CR

Given the previously cited results, a significant portion of studies emphasized the importance of assessing multiple proxies of CR simultaneously given their synergistic contribution to overall CR levels (Evans et al., 1993; Mortel, Meyer, Herod, & Thornby, 1995; Stern et al., 1994; Stern et al., 1995). This has led to several attempts of developing multidimensional scales for measuring CR: Cognitive Reserve Questionnaire (Rami et al., 2011), Cognitive Reserve Scale (León, García-García, & Roldán-Tapia, 2014) for Spanish speakers, and Cognitive Reserve Index Questionnaire (CRIq; Nucci, et al., 2011), which has been translated to several languages (translations are available at www.cognitivereserveindex.org) leading to its more frequent use and validations. CRIq covers three domains – Education, Work Activity, and Leisure time, enabling calculation of CR scores for each domain as well as the overall CR index. Considering a growing body of literature aiming to provide answers related to the conceptual nature of CR, its neural basics and overall potential of its clinical usefulness and, at the same time, lack of the consensus how it should be measured, studies oriented toward understanding of constituents of CR should be prioritized. While it was rarely investigated in healthy participants (e.g., Arcara et al., 2017; Puccioni & Vallesi, 2012; Yaneva, Massaldjieva, Mateva, & Bakova, 2019), most of the CRIq data are available in clinical population (e.g., Ihle et al., 2020; Milanini et al., 2016. Therefore, this study aims to address the validity of Serbian translation and adaptation of CRIq in healthy participants (Nucci et al., 2011) and provide some directions for its practical implementation. This is the first study of this kind in Serbian population. In addition to CRIq, measures of intelligence, cognitive flexibility and phonemic fluency are administered to address the issue of congruent validity. Finally, we aim to test if there are any age and gender differences in Overall CRI, as well as in its subdomains.

METHOD

Sample and procedure

Sample in this study included 117 (61% female) healthy adult participants from Serbia. The age ranged from 19 to 86 (*M* = 41.37, *SD* = 21.91) and participants were divided into three different categories: young adults from 18-35 years old (*N* = 63, *M* = 23.43, *SD* = 3.32*)*, middle-aged adults from 36-55 years old (*N* = 19*, M* = 47.52*, SD* = 5.82*)* and older adults, over 55 years old (*N* = 34*, M* = 71.18*, SD* = 9.05). Social networks were used for study advertisement and only participants without diagnosed neurological condition were recruited. Testing was conducted over the course of 6 months (from December 2017 to June 2018) at the Center for memory disorders and dementia at Clinical Center of Vojvodina, by a group of graduate and undergraduate students who were previously trained in neuropsychological and psychological assessment using the same battery of instruments that has been used to collect the data for this study. The study has received ethical approval. The participants were informed about the nature and the details of the study, after which they choose whether they want to participate or not. Written consent form was obtained for every subject.

Instruments

Cognitive Reserve Index Questionnaire (CRIq; Nucci et al., 2011). For the purpose of this study CRIq was translated from English to Serbian with minor adaptations according to Serbian cultural context. Permission for translation has been obtained from the original test authors. Originally, CRIq was created for Italian speaking population as an attempt to provide a standardized measure of CR that is potent to overcome CR assessment shortcomings that have been recognized in earlier studies (e.g., inconsistency in variables that were considered as proxies of CR, as well as inconsistency in their measurement). CRIq has three sections for assessing three different proxies of CR: Education (both formal and informal), Work activity (occupational attainment with different levels of required skills and qualifications) and Leisure time (activities carried out continuously, weekly, monthly and annually). However, leisure activities are coded only if they are carried out frequently (e.g., at least three times a week/month/year).

Wechsler Adult Intelligence Scale – Information subscale (Berger, Marković, & Mitić, 1995; Wechsler, 1981). In this study, only Information subscale from Serbian version of WAIS was used. This scale has thirty questions related to a general knowledge. In clinical practice it is often use as an indicator of premorbid capacities because it requires an access to a long-term memory which is assumed to stay intact the longest in case of ongoing pathological processes.

Color Trails Test (CTT; D'Elia et al., 1996). CTT is a culture-fair alternate form of TMT, hence a measure of visuo-perceptual scanning, graphomotor sequencing and cognitive flexibility. Form A consists of 25 numbers, with even numbers in pink circles, and odd numbers in yellow circles. Participants are instructed to connect all the circles following the sequence of numbers from 1 to 25, as fast as possible, ideally without lifting a pencil from the paper. Form B is slightly more complex. It contains sequence of 25 numbers, all colored in both yellow and pink variant. Participants are instructed to connect numbers from 1 to 25 by using pink and yellow circles interchangeably (starting from the pink colored number 1, connecting with number 2 in yellow, then with number 3 in pink, and so on). For both forms time until the completion and number of errors are recorded.

Test of phonemic and semantic verbal fluency (FF-KK; Pavlović, 2003). FF-KK is Serbian adaptation of Benton Controlled Oral Word Association (COWA) Test (Benton & Hamsher, 1976) used in neuropsychological assessment. To assess verbal phonemic fluency participants are instructed to name as many as possible words starting with S, K and L, and for assessment of semantic verbal fluency animal naming is used. Participants have 60 seconds per task. Total number of words per phoneme is calculated. Total number of named animals is used as an indicator of semantic verbal fluency.

Data preparation

CRIq scores were computed according to the recommendations proposed by Nucci et al., (2011). Since CRIq scores are based on the number of years activities have been practiced they were highly correlated with age: Working Activity $r = .76$ ($p < 0.01$); Leisure time $r = .70$ ($p < 0.01$), overall CRI (created as an average scores of three CR domains) $r = .74$ ($p < 0.01$), except Education domain which correlated -.10 ($p > 0 .05$) with age. To rule out this effect of the age, four linear regressions were conducted using one of the CR proxies as a criterion and age as a predictor in order to create standardized residuals that were used for further analyses. Additionally, obtained residualized scores were transformed into a scale with $M = 100$ and $SD = 15$ for the ease of comparison within each age class (Nucci et al., 2011).

RESULTS

In Table 1 are presented descriptive statistics for the scores obtained from the instruments used in the study. According to Curran et al., recommendations (Curran, West, & Finch, 1996), values greater than ±3 for skewness, and greater than ± 10 for kurtosis were considered as potentially problematic.

Table 1. *Descriptive statistics for the variables used in the study*

	N	*Min*	*Max*	*M*	*SD*	*Skewness*	*Kurtosis*
CRI: Working activity	115	0	75	18.74	18.86	0.81	-0.23
CRI: Leisure Time	115	14	550	147.03	109.77	1.05	0.84
CRI: Education	115	1	30	16.12	3.59	0.51	4.76
Overall CRI	115	8.67	208	60.63	41.12	0.93	0.52
WAIS: Information	117	6	30	23.20	5.27	-1.31	1.72
FF-KK: S	117	2	22	11.02	4.29	0.23	-0.27
FF-KK: K	117	3	21	12.44	4.09	-0.28	-0.19
FF-KK: L	117	2	19	10.38	3.87	0.15	-0.55
FF-KK: Animal naming	117	8	37	17.81	4.92	0.72	2.01
CTTa: Time	117	15	170	50.56	26.82	2.02	5.39
CTTa: Errors	106	0	2	0.06	0.27	5.26	29.94[a]
CTTb: Time	117	37	334	96.99	54.38	2.06	5.04
CTTb: Errors	106	0	4	0.21	0.66	4.26	20.53

Note: Presented are descriptives for raw CRI scores.

Age and gender differences in CR

To assess age differences *One-way ANOVA* was applied comparing young, middle-aged and older adults on standardized and transformed Education, Working activity, Leisure time and Overall CRI scores. The obtained results were suggestive of small but significant effect of age on Working activity $F\ (2,111) = 6.225$, $p = 0.003$, $\eta^2 = 0.101$, Leisure time $F\ (2,111) = 3.799$, $p = 0.025$, $\eta^2 = 0.064$ and Overall CRI $F\ (2,111) = 5.110$, $p = 0.008$, $\eta^2 = 0.084$, while the effect of age on Education was not statistically significant $F\ (2,111) = 1.261$, $p = 0.287$, $\eta^2 = 0.022$. Further multiple comparisons have been done using Scheffe post-hoc analysis and the results are presented on Graph 1. For Working activity score significant differences have been recorded between young adults and middle-aged adults ($p < 0.01$) and between middle-aged adults and older adults ($p < 0.01$). Next, there was significant mean difference between young adults and middle-aged adults on Leisure time score ($p < 0.05$). However, given that the mean score for older adults differs from the mean score for younger adults for only 0.02, we could assume that the significant difference would be registered between middle-aged ($N = 19$) and older adults ($N = 34$) as well, in case of a larger sample size. Finally, post-hoc

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[a] Due to low frequency of registered errors on CTT and unacceptably skewed data, these variables were omitted from further analyses.

analysis revealed significant differences in Overall CRI between young and middle-aged adults ($p < 0.05$) and between middle-aged and older adults ($p < 0.05$).

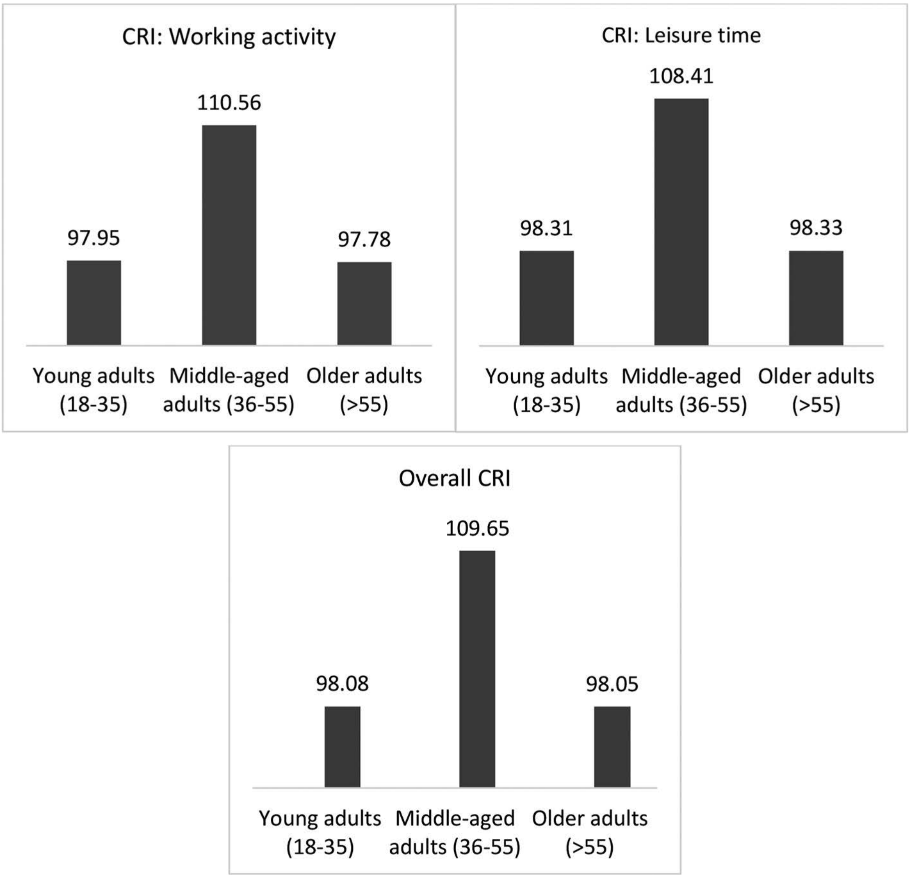

Figure 2. Results of Scheffe post-hoc test for multiple comparisons

Gender differences were tested using *t*-test for independent samples. As seen in Table 2, no significant gender differences were found on Education, Working activity, Leisure time or Overall CRI.

Table 2. *T-test results for gender differences on CRIq scores*

CRI proxy	Gender	*N*	*M*	*SD*	*t*	*df*	*p*
Education	male	44	100.62	14.82	0.35	112	0.725
	female	70	99.61	15.10			
Working activity	male	44	97.89	12.04	-1.20	112	0.233
	female	70	101.33	16.44			
Leisure time	male	44	98.22	17.55	-1.01	112	0.316
	female	70	101.12	13.04			
Overall CRI	male	44	98.33	17.82	-0.94	112	0.347
	female	70	101.05	12.82			

Within Table 3 average CR scores were presented separately for females and males, across gender groups. Age range for females was from 20-86 (*M* = 41.51, *SD* = 21.68), and for males 19-85 (*M* = 41.15, *SD* = 22.52), and applied *t*-test yielded non-significant age differences between genders *t* (114) = -0.084, *p* <0.05.

Table 3. *Average CR scores for males and females across age groups*

	Age	N	Education	Working activity	Leisure time	Overall CRI
Male	Young adults (18-35)	25	95.36	97.71	97.48	97.10
	Middle aged adults (36-55)	5	117.56	122.68	125.13	127.66
	Older adults (>55)	14	95.38	97.96	89.94	90.05
Female	Young adults (18-35)	36	101.92	98.11	98.89	98.76
	Middle aged adults (36-55)	14	100.41	106.23	102.45	103.22
	Older adults (>55)	20	100.91	97.66	104.20	103.64

CR and cognitive functioning

Upper section of Table 4 shows Pearson's coefficient of correlation for CIRq scores: Education, Working activity, Leisure time, Overall CRI. While subscales demonstrated small-to-moderate correlations among each other, overall CRI score correlate moderately with Education and Working activity, and almost perfectly with Leisure time.

Table 4. *Pearson correlations between CRI scores and cognitive functions*

	Education	Working activity	Leisure time	Overall CRI
CRI: Education	--	0.252**	0.413**	0.467**
CRI: Working activity	--	--	0.215*	0.359**
CRI: Leisure time	--	--	--	0.988**
WAIS: Information	0.287**	0.131	0.158	0.179
FF-KK: S	0.164	-0.085	0.067	0.058
FF-KK: K	0.153	0.014	0.121	0.122
FF-KK: L	0.114	-0.08	0.043	0.034
FF-KK: Animal naming	0.211*	0.099	0.061	0.08
CTTa: Time	-0.203*	-0.073	-0.184	-0.192*
CTTb: Time	-0.167	-0.04	-0.117	-0.123

Note: ** *p* <0.01, * *p* <0.05

For testing convergent validity of CIRq scores Pearson correlations were calculated between Education, Working activity, Leisure time, Overall CRI and different measures of cognitive functioning. Education correlated positively with WAIS Information subscale which is usually used as a measure of premorbid intelligence, and categorical fluency, and negatively with time to task completion on CTT Form A (all three obtained effects were small). Overall CRI correlated significantly only with time to completion of CTT Form A in a negative direction.

DISCUSSION

Passive and active models of reserve were developed in an attempt to explain lack of direct relationship between the degree of a present brain pathology and manifest cognitive impairment (Stern, 2002). Key concept within the passive models is brain reserve, while CR represents key element of the active ones, with an idea that former is determined by innate characteristics, while the latter is shaped by lifelong, cognitively stimulating experiences. Given that CR cannot be directly measured it is yet to be determined which activities that people are practicing during the life are playing the role in building CR, which serves as a protective factor from non-pathological age-related cognitive decline in healthy people and serves as a buffer when brain pathology is already present. In the latest years, studies have shown that education, occupation and cognitively stimulating leisure activities seem to be the most prominent proxies of CR. However, different scales were used for the assessment of those proxies, and they were rarely presented all together within the same study, which causes difficulties in comparing the results across different studies. Cognitive Reserve Index questionnaire (CRIq; Nucci et al., 2011) was developed with an idea of overcoming described shortcomings of previous studies by providing a standardized measure of CR that incorporates those proxies that most of the studies argued for – education, working activity and leisure time. Education is measured through reported number of years of formal and informal education, working activity through number of years spent engaging in different levels of professional occupation, and Leisure time through years of practicing different stimulating activities such as reading, going to the movies, driving, etc. CRIq enables calculating scores for each proxy as well as overall CR index (averaged value based on subscale scores). The questionnaire was translated to several languages so far, and the aim of this study was to address validity issues of its Serbian translation and adaptation using a community sample consisted of healthy participants (without diagnosed neurological conditions). After controlling for the effect of age due to its linear relationship with scores, age differences were tested, and the obtained results were fairly similar to those reported in studies in different languages (Maiovis et al., 2015; Nucci et al., 2011) with significant differences on Working activity, Leisure time and Overall CRI, but not on Education. In addition, post-hoc analyses revealed the same pattern of the results as it was previously reported (Maiovis et al., 2015; Nucci et al., 2011) with middle-aged adults scoring higher on Working activity, Leisure time and Overall CRI in contrast to young and older adults. In addition, age differences in Working activity and lack of gender differences are consistent with Yaneva et al.'s study (Yaneva, et al., 2019).

Investigating correlations among CRIq subscales as well as correlations between CRIq subscales and different measures of cognitive functioning several important remarks have been made. Firstly, taking into account very high correlation between Overall CRI and Leisure time scale we do not recommend usage of the Overall CRI score until additional independent data using this questionnaire are not collected. Obtained correlation may suggest that the most salient aspect of Overall CRI are leisure activities meaning that Overall CRI calculated as an average value based on three CR subscales is not a representative measure of general CR. However, high correlation between the

Overall CRI and CR subscales has been found in the study by Nucci et al. (2011) where Overall CRI correlated .80 with Education and Working Activity, and .70 with Leisure time. Moreover, significant but low correlations between different CR aspects may reflect the importance of assessing different lifelong activities when measuring CR and they go in line with all previously reported notions that all these aspects (i.e., education, occupation, and leisure time) should be considered if one strives to capture the real picture of person's CR. Low correlations between subscales are consistent with those reported by Italians and Greeks (Maiovis, 2016; Nucci et al., 2011). However, we assume additional efforts need to be made when calculating CR scores based on CRIq. Such score should be able to differentiate, for example, those who were engaged in activities that require different amounts of cognitive load, or in jobs that require different qualifications and different type of investment (e.g., cognitive versus physical). This could possibly be done by weighting responses in each section differently. In addition, relations between CRIq scores and Information subscale from WAIS, phonemic fluency, semantic verbal fluency and time needed to complete TMT (forms A and B) which is a measure of visuo-perceptual scanning, graphomotor sequencing and cognitive flexibility were explored. The obtained results showed that only greater score on Education subscale was related to better cognitive performance on TMT form A, animal naming and Information. The only other significant result suggested that Overall CRI score was related to better performance on TMT form, too. These findings are comparable with those reported by Puccioni and Vallesi (2012). Namely, these authors reported that higher CRI was significantly associated with better cognitive control measured by Stroop, suggesting that better CR can bypass age-related attentional impairments. But, as it has already been noted, results that include Overall CRI score in this study should be taken with caution as it is not clear how it should be interpreted. Based on the pattern of the results this study yielded it could be argued that after all only Education subscale seems to be useful when assessing CR because it is the only subscale that was related to several measures of cognitive functioning, and these results provided some evidence for convergent validity for Education proxy only. Nonetheless, sample size used in this study was considerably small and it might be the case that the study was underpowered to detect other significant effects. Furthermore, significant but relatively small correlation obtained between Education subscale and Information subscale, and lack of significant correlation with other CR proxies, imply that Information score is probably not the best choice, or at least should not be used alone for the assessment of premorbid cognitive functioning as it has been usually done in clinical practice. Other possible explanation for the lack of significant relations between CR and used measures of cognitive functioning is that these measures of cognitive functioning were not enough cognitively demanding for healthy participants, hence the performance was not depending on their CR levels. Thus, other measures of cognitive functioning should be considered when addressing the CR questions in nonclinical samples. Alternatively, these cognitive measures could be used with additional cognitive load. Frequency of the type of the activities that had a role in constituting Working activity and Leisure time scores (e.g., knitting vs. playing chess) need to be explored further because it may affect the way these scores behave in relationship with other variables. Finally, conclusions based on this study data are somehow limited with its cross-sectional nature.

To sum up, given that this is the first study examining Serbian version of CRIq, additional studies that include larger samples, as well as inpatient samples are necessary before making final conclusions related to the scale. However, based on this study we highly recommend choosing subscale scores for assessing CR over Overall CRI score. Finally, this version of CRIq seems to be a promising tool for the assessment of CR since it reflects some of the characteristics that were reported in previous studies for its other versions (Maiovis et al., 2015; Nucci et al., 2011; Puccioni & Vallesi, 2012; Yaneva, et al., 2019) showing that there is some stability and consistency within its multiple administrations even in different cultural contexts.

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MODERN APPROACH TO NEUROPSYCHOLOGICAL ASSESSMENT AS A PREDICTOR OF COMPUTERIZED COGNITIVE REHABILITATION

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SUMMARY

Neuropsychological tests are specially designed tasks used to assess cognitive function, known to be related to a particular brain structure or pathway. The modern approach in neuropsychological assessment involves the application of the test in a computer application. This approach has many advantages, simple application of other technology and sensors, to get as informative the data. The purpose of this research was to analyze the possibilities for realization of certain neuropsychological tests in the form of computer applications, with the use of an additional sensor and application of the data obtained in rehabilitation. The Wisconsin Card Sorting Test - WCST, a card sorting test, was used as an example of the test. The survey included 20 respondents from the regular population, ages 17-29, selected by the random sample method, who voluntarily accepted to participate in the research. Respondents solved the test in a computer application with an additional sensor attached to an Emotiv Epoc Electroencephalograph. The results show that it takes less time to solve the test in a computer application and that errors that the examiner may make are excluded. Moreover, the additional sensor provides accurate data on registered features that can be used in diagnostics as well as in rehabilitation. All this information cannot otherwise be obtained by the usual test method.

Key words: neuropsychological assessment, computer test application, electroencephalograph

INTRODUCTION

Neuropsychological tests are specifically designed tasks used to measure a psychological function known to be linked to a particular brain structure or pathway. Tests are used for research into brain function and in a clinical setting for the diagnosis of deficits. Detailed neuropsychological evaluation can provide data on different cognitive domains as well as neuropsychiatric and behavioral features (Harvey, 2012).

The rapid advancement of technology, including improved computer programming, has enabled an increasing number of researchers and clinicians to begin using different technologies to improve the efficiency, reliability, and cost-effectiveness of neuropsychological assessment (Zucchella, Federico, Martini, Tinazzi, Bartolo, & Tamburin, 2018).

A computer-assisted test enables the synchronized application of other technologies and additional sensors in order to obtain different and significant data (Parsey & Schmitter-Edgecombe, 2013).

It is considered that the potential of technology use in neuropsychological assessment has not yet been realized, and continued adoption of new technologies could result in more comprehensive assessment of cognitive dysfunction and in turn, better informed diagnosis and treatment (Bilder & Steven, 2018).

Research to date has shown of advantages of computerized assessment, including simplicity; precision of measurement; shorter assessment time; standardization; automatic scoring; and minimization of subjectivity, as well the impact examiners may have on participant. Research has shown disadvantages too, for example reliance on the visual modality; provision of less qualitative information than pencil-and-paper tests, and participant unfamiliarity with computers (Howieson, 2019).

Computerized tests have the advantage of algorithmic design, which can be used to tailor testing for specific populations (Germine, Reinecke, & Chaytor, 2019).

By embracing the utility of technology to provide additional measures, neuropsychological assessment could expand the ways in which cognitive deficits are evaluated and ultimately treated. In the case of conducting cognitive rehabilitation using a computer, it is easier to induce motivation for therapy because direct feedback can be given to patients regarding the performance result in comparison with cognitive rehabilitation, and this type of training can not only provide flexibility but may also shorten rehabilitation time.

An important aspect of neuropsychological assessment is qualitative, that is, observations of the processes by which the subject responds to the test situation (Barr, 2008). This is the basic basis for defining algorithms in the design of computer cognitive rehabilitation. Some studies suggest that continuous computerized cognitive rehabilitation of several months or longer may improve the cognitive abilities of individuals with low cognitive abilities (Yoo, Yong, Chung, & Yang, 2015).

Objective

This research analyzes the possibilities for realization of certain neuropsychological tests in the form of computer applications. As an example of the test, WCST was used. The possibilities for synchronized application of additional sensors during the WCST test in the form of a computer application have been analyzed. For this purpose EEG device "EMOTIV EPOC" Application My Emotivator was used, to measure and record the variability in emotional performances depending on various external factors. Finally, to anticipate opportunities for implementation of computerized cognitive rehabilitation.

METHOD

Participants

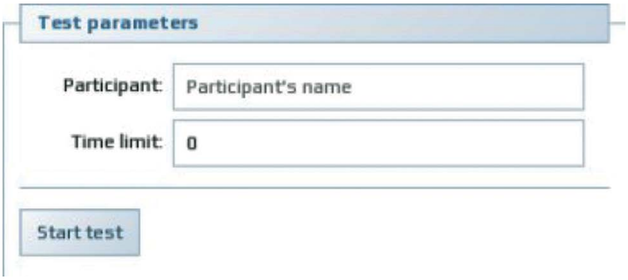
The study involved 20 participants, aged 17-29 years, selected by random sampling method. Subjects were given a computerized version of the test with an additional sensor. The criteria for inclusion in the study were the absence of neurological and psychiatric disorders, as well as addictive diseases. Be aware of the research procedure and application of the device and have voluntarily agreed to participate. Ethics committee approval was obtained for conducting this research in accordance with the principles of the Declaration of Helsinki.

Neuropsychological assessment

The Wisconsin card sorting test - WCST is most commonly used to evaluate executive functions. It is a sorting test and the most famous test for discovering perseverance and mental rigidity. The WCST may be performed on a computer (Heaton & Staff, 2003). The possibility of using the WCST test in a computing version is advantageous in comparison to the classic way of applying the test. The administration of the computer test solution is very simple, allowing it to be widely applied on a different population sample. The respondent watches the stimulus cards, when the offered card appears on the screen, the respondent gives the answer, the match with the stimulus card according to some criterion (color, shape, number) on the stimulus card. Respondents are not given too detailed instructions for solving the tests, the essence is that they come to a solution based on feedback in the form of a (different) sound signal that will record an accurate and incorrect response. The advantage of solving a computer test is that the test is done more easily, more efficiently and quickly, regardless of the fact that the test is not time-limited. The respondent does not have a retroactive view of the offered ticket which was an accurate or incorrect answer. This requires the respondent to remember the offered ticket. However, this has a positive effect on the capacity of short-term memory. As an example of application that we have used for HCI-MAP platform demonstration we took Wisconsin Card Sorting Test.

Detection of tested properties by EEG device “EMOTIV EPOC“

WCST application is developed as a Web application, by using the JavaScript, HTML5 and CSS languages. The application consists of 4 different screens: initialization, begin form, card selection and results. The initialization screen is displayed while the WCST application is loading, and the most important part of this process is time synchronization with HCI-MAP server. After the time is synchronized, the begin form screen is displayed.



Test parameters

Participant: Participant's name

Time limit: 0

Figure 1. Begin form screen of the WCST application

The begin form is displayed at Fig. 1. This form contains only two fields - one for participant's name and one for test time limit. The time for taking this test could be limited by inserting number of seconds in the *Time limit* field. After entering these values, the participant can click the *Start test* button and proceed to the test itself.

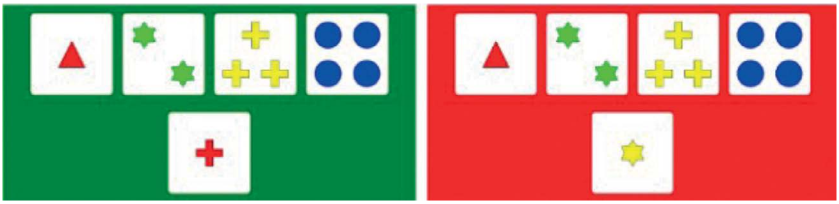
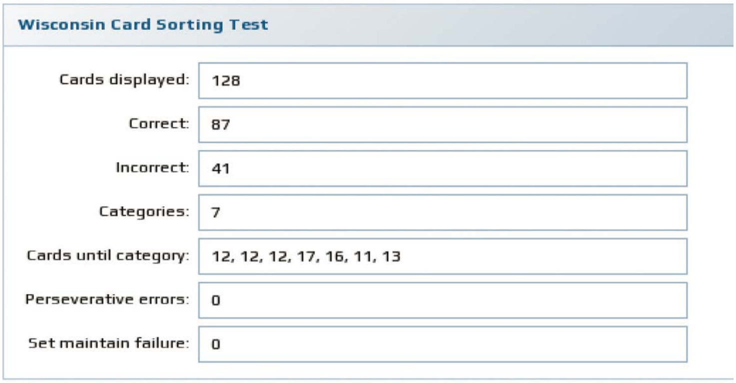


Figure 2. Screen after selecting a correct (left) or incorrect card (right)

The test's main screen is given on the Figure 2. The screen consists of five cards - four static, displayed as a stimuli, and one active card, displayed at the bottom row. The active card is picked from the deck (128 cards total), and the participant is asked to choose one card from stimuli set, according to some criteria (shape, color, or number). If the chosen card is correct, the screen background color is changed to green, and an appropriate sound is played. Otherwise, if chosen card is not the correct answer, the screen goes red and an appropriate sound is played. The test is over when all 128 cards from deck are displayed. After that, the result screen is displayed (Fig. 3).



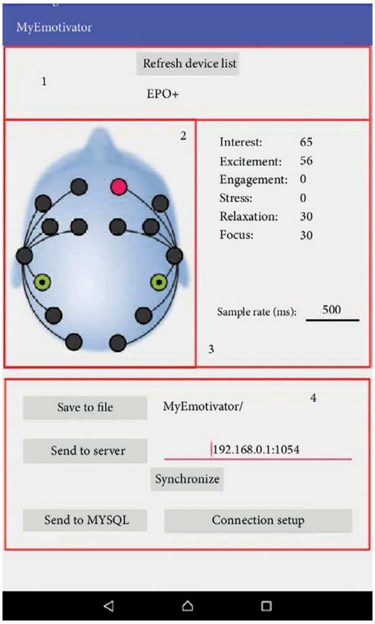
Wisconsin Card Sorting Test

Cards displayed: 128
Correct: 87
Incorrect: 41
Categories: 7
Cards until category: 12, 12, 12, 17, 16, 11, 13
Perseverative errors: 0
Set maintain failure: 0

Figure 3. The results screen

First, we extract features from the EEG signals in order to characterize states of mind in the arousal-valence 2D emotion model. Using these features we apply machine learning techniques to classify EEG signals into high/low arousal and positive/negative valence emotional states. The obtained classifiers may be used to categorize emotions such as stress, relaxation, excitement, and calm based on EEG data (Ramirez & Vamvakousis, 2012).

Application My Emotivator measures and records the variability in emotional performances depending on various external factors, with the EMOTIV EPOC+ device (Fig. 4). Using algorithms to calculate the values of six emotional states (interest, engagement, excitement, stress, relaxation and focus) based on gathered EEG data, this



EPO+

Interest: 65
Excitement: 56
Engagement: 0
Stress: 0
Relaxation: 30
Focus: 30

Sample rate (ms): 500

MyEmotivator/
192.168.0.1:1054

Figure 4. Sections of My Emotivator app Main window

application is capable of displaying, processing and saving the measured information for use in real-time analysis by other services or humans. Within a wider platform, we implemented an option for synchronized pairing with other human-computer interaction (HCI) components to obtain a complete picture of the user–environment interaction.

The recommended procedure for connection to the EMOTIV EPOC+ device involves turning on the device and searching for active devices in the Bluetooth domain (Fig. 4, Section 1). When the desired EPOC+ device name is selected by the user, the application begins the process of connecting with the device. Under normal conditions, this process takes 1–2 seconds, although this may be increased when there is a large physical distance between the EPOC+ and the mobile device or if the battery is low. After successful pairing, the application stops the scanning process and starts the quality testing phase of the channel contact.

The application can uniquely determine the name of the channel that is sending the signal and can visually display its position on the head. There are three levels of signal strength: no signal, bad signal and good signal. Based on the detected level of signal quality, the connector positions are shown in a different color in the corresponding picture on the main window: red, orange or green (Fig. 4, Section 2). Data about the emotional performances are gathered simultaneously with the quality information. The default reading frequency is set to twice per second (500 ms). Each of the six values examined fall into the range 0–100, where 100 is the maximal emotional level for the user, and 0 represents a theoretical minimum (Fig. 4, Section 3). In addition to the six main emotional states, the application also saves the exact time of the measurement in the UNIX timestamp format for use in later analysis.

Statistical analysis

Comparison of the obtained results of the subjects with the reference values of the test used was performed by arithmetic mean, standard deviation, t test. Data processing was performed in SPSS Statistical Package, version 17.

RESULTS

Table 1. *Characteristics respondents included in the study*

Characteristics		Respondents	
		number (n=20)	% (percent)
Gender	Male	17	85%
	Female	3	15%
Age	Mean (SD)	23 (3.68)	
Education	Basic (8 years)	0	0%
	High school (12 years)	7	15%
	College /Higher (16 years)	13	86%

Table 2. *The results of the examined executive functions by the WCST test with computer application*

Parameter	Normative test values M (SD)	Group of respondents M (SD)	Differences in relation to normative values (t)	p-value
Number of categories reached	5.9 (0.5)	3.90 (2.49)	t(3.59) = 2.09	< 0.05
Number of attempts to first category	12.2 (3.9)	37.40 (32.61)	t(3.45) = 2.09	< 0.05
Persevering errors	10.3 (6.4)	4.80 (3.82)	t(6.44) = 2.09	< 0.05
Errors in maintaining the set	1.83 (1.87)	1.00 (0.97)	t(3.81) = 2.09	< 0.05

Legend: M – arithmetic mean; SD – standard deviation; t – test; p< 0.05

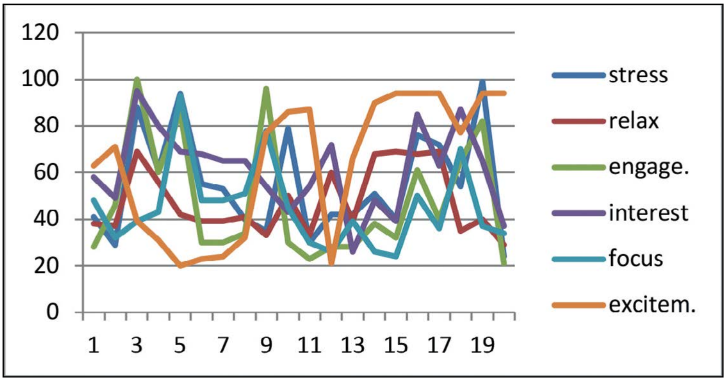


Figure 5. Graphical representation of the registered properties using EEG device at the beginning of the test using the WCST test application

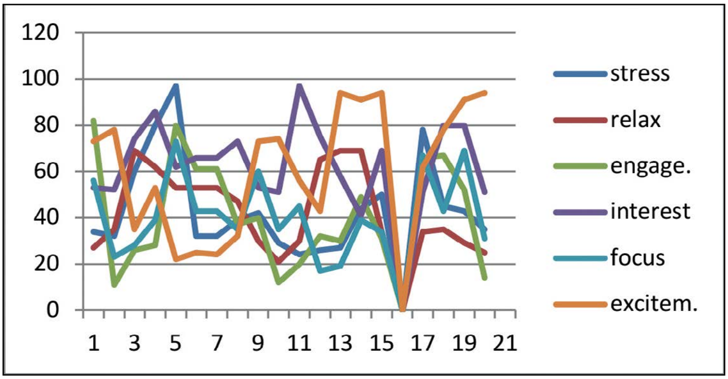


Figure 6. Graphical representation of the registered properties using EEG device at when achieving the first category in the test using the WCST test application

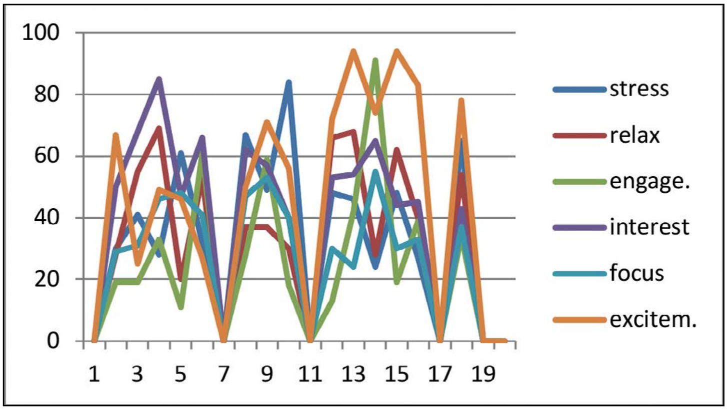


Figure 7. Graphical representation of the registered properties using EEG device for persevering errors in the test using the WCST test application

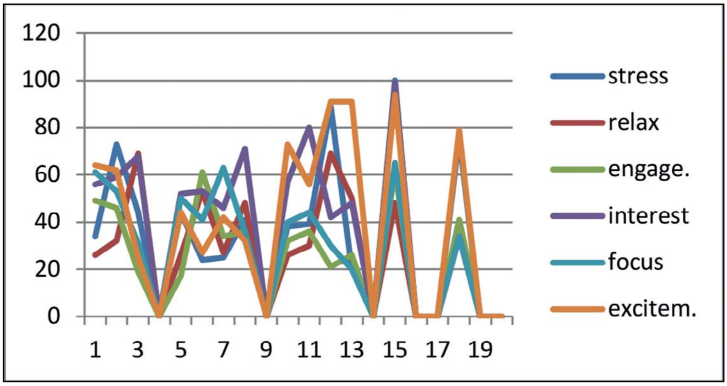


Figure 8. Graphical representation of the registered properties using EEG device in the abandonment errors in the test using the WCST test application

Comparing the obtained values of the examined variables with the normative values of the test in the respondents who did the test in a computer application with an additional sensor included, a statistically significant difference in the number of perseverative responses was obtained $p = 0.00$; $t = -17.152$; $df = 19$; $p < 0.05$ and in the number of attempts to reach the first category $p = 0.00$; $t = 3.455$; $df = 19$; $p < 0.05$ (Table 2).

The results of the electroencephalographic EEG device “EMOTIV EPOC“ for detecting certain properties indicate that engagement and stress were present in a high percentage in the majority of the subjects at the beginning of the test (Figure 5). Excitement and interest were detected when reaching the first category (Figure 6). With perseverative responses, excitement was registered (Figure 7), whereas with failure to set off, stress was registered (Figure 8).

DISCUSSION

The application of the neuropsychological test provides an opportunity to examine each of the brain functions separately, specific enough and sensitive enough to make the test reliable and objective. Therefore, it is very important how the neuropsychological assessment will be applied and in what way. A Wisconsin card sort test in a computer application was used for research purposes (Jevremovic, Arsic, Antonijevic, Ioannou, & Garcia, 2018). Basically it is a test for evaluating executive functions. They make our behavior conscious, controllable and adaptable (Galindo-Aldana et al., 2018). Execution processes are multiply connected with other cognitive systems via a rich neuroanatomical network, so the choice of the test to design this study was appropriate.

Despite the new and still poorly implemented computerized testing method, the majority of respondents had high motivation during the testing process. This observation is compatible with the results of a research study that found out that there was generally a more positive view of computerized tests, primarily because they are simple to use and they need less time for solving (Ling, Attali, Finn, & Stone, 2017).

The design of the WCST test itself does not limit the time it takes to complete, therefore the total time depends on the subjects. In the standard version of the test solving, as well as in the computer application, time can be extended by the latencies present between the responses. However, the latency effect is much shorter by using computer application. This kind of test solving in a computer application seems to trigger maximum mental engagement, activate short-term working memory and maintain the quality of attention. Theoretically, significant engagement of attention and short-term working memory, as a part of executive functions, increases multifactoriality in assessment and contributes to the quality of the results obtained. As neuropsychological assessment is multidimensional in nature, the quality of the results obtained may facilitate identification of primary and secondary cognitive deficits, may determine functional limitations, and contribute to the treatment planning (Casaletto & Heaton, 2017). The results of this study may serve to construct a platform for the application of a computerized cognitive rehabilitation system. For the purposes of this study, a test was used to evaluate execute functions (which, among other things, control a person’s behavior), so that the basic design of computer-cognitive rehabilitation would find tasks that closely mimic social reality. However, the generalization of the results obtained is limited by the small sample used in this study. Although, according to some studies, small samples are often used in EEG studies.

The design of our study allowed us to attach an additional EEG EMOTIV EPOC electroencephalograph sensor during applying the computer test application. An additional sensor registered excitement, engagement, relaxation, stress and focus. Besides detection, it recorded the time of occurrence as well as the percentage representation of these features during significant periods in the test itself. The values of the detected traits were monitored at the very beginning of the test, at the achievement of the first category, at errors in maintaining the set, and at perseverative responses. The precise recording and measuring of these traits contribute to a qualitative analysis of the results relevant to the field of cognitive and emotional (López Gil et al., 2016).

The use of an additional sensor is useful and provides additional and important data, which cannot be obtained by the conventional method (Justin & Barr, 2017).

In recent years, considerable attention has been directed towards analyzing the presence of certain emotions at the time of rational decisions. Using an additional sensor while solving a test in a computer application, allows you to get accurate information about the emotions involved (Schwarz, 2010).

Digital devices are now widely available and have the ability to measure aspects of human behavior accurately. This advantage of using a computer application in neuropsychological assessment certainly affects the precision and efficiency of diagnostics but also to rehabilitation planning. Based on a qualitative and quantitative analysis of achievement using a computer-aided neuropsychological assessment method with the synchronous inclusion of an additional sensor, it would be possible to adapt to the capabilities and difficulties of the test person. Based on immediate feedback, an appropriate program would be constructed that would be effective, fit for therapeutic purpose, and based on verified results. The positive effects of computerized cognitive rehabilitation could be the quality of visual perception, visual learning, memory as well as attention performance. Adjusting for achievement performance rather than trait characteristics could be a problem in creating a platform for computerized cognitive rehabilitation. Perhaps a more comprehensive study will offer better opportunities.

Limitations of study

The limitation of the study is reflected in a limited number of subjects, which may limit the reliability of the conclusions. The study was done only on healthy subjects. It would be desirable to expand the research to include persons with neurological impairment. With more diverse data, there would also be more options in defining computer cognitive rehabilitation.

CONCLUSION

Computerized neuropsychological testing has many advantages over traditional testing as it is characterized by reliability and sensitivity to very discrete changes in cognitive functioning, standardization in the administration and processing of tests, the ability to create numerous variants of tests for repeated testing, precise control of stimuli, the ability to monitor different aspects of respondent responses and the ability to create reliable databases.

Considering the advantages of using the computer-based testing method shown by the results of this study, especially with regard to the results obtained, suggests that computer availability would be very important in the process of neuropsychological testing and most importantly, enables synchronous incorporation of other technology to obtain more informative data. In addition, the modern approach in neuropsychological assessment offers great opportunities for the application of the modern approach in cognitive rehabilitation.

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PSYCHOTHERAPY AS A SUPPORTIVE METHOD IN DEFECTOLOGICAL TREATMENT

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SUMMARY

Psychotherapy was, at the very beginning, only a method of treating neurotic disorders in psychiatry, but over time it has gone beyond medicine and become accepted in solving everyday life problems and improving the quality of life of well-adjusted people, too. In this way, it imposed and fought for its place in all developed cultures. Besides, because of its broader connection with many social and human sciences (pedagogy, sociology, ethics, law, linguistics, philosophy, religion, psychology, art, defectology, etc.), it is considered to be a certain civilization achievement that significantly marks the modern age.

In addition to the general problems of psychotherapy as a supportive method in defectological treatment, we have paid special attention to behavioral therapy and its application in defectology within each of its branches. Based on the analysis performed, it is generally concluded that, despite the relevant results of the relatively widespread use of behavioral-cognitive therapies in working with children and young people (as well as adults) with disabilities, there is a lack of a more comprehensive theory on the development and elimination of sensory, cognitive and social disabilities, as well as the treatment of mental disorders in the population of individuals with developmental disabilities. Therefore, we need appropriate research that will provide new insights and more accurate data on the true value, as well as disadvantages and advantages in relation to other approaches in the treatment of this population.

Key words: supportive method, psychotherapy, behavioral therapy, disorders in development

INTRODUCTION

Psychotherapy is in its basis an ancient healing skill whose beginnings date back to primitive social communities. However, psychotherapy took its definitive form as a healing skill only in the late 19th and early 20th centuries with the development of psychoanalysis and psychoanalytic psychotherapy by a well-known Viennese physician, professor of psychiatry, Sigmund Freud (Sigmund Freud 1856-1939), who is considered the teacher of all psychotherapists. In the last ten years of the 19th century, based on the experience of numerous predecessors (first of all, physicians, philosophers, and scientists), he presented his theory, psychoanalysis, which sought to challenge the exclusive primacy of biological factors in the emergence and treatment of psychological disorders and to draw attention to the importance of psychological factors. Freud emphasized that psychiatric disorders do not represent only certain brain diseases, but that they must be viewed through the relationship of organic and psychic, body and soul, that is, viewed in the light of -and-and relations, and not at all -or-or relations because psychopathological phenomena can best be understood only if viewed both ways.

Certain studies carried out at the end of the 20th century indicated that psychotherapy was not an impressionistic discipline based on hypothetical constructs of psychoanalysis and speculation, but rather that it became a scientific discipline. Also, the findings confirmed the fact that all mental disorders arise as a result of the interaction of three factors: congenital dispositions, developmental traumas, and social factors. This interaction is best represented in an already classic bio-psychosocial model that imperatively imposes the need for all disorders to be treated with an integrative approach without the existence of -or-or division. Certainly, grandiose studies of brain plasticity have provided all of this additional confirmation of the scientific basis and its apparent and biological activity, which have shown that the brain is constantly responding to all external stimuli, including words, which are the basic instrument in psychotherapy.

The term "psychotherapy" today encompasses more than 400 theoretical directions, procedures, forms and methods of treatment, of which there is a very extensive literature. What characterizes each approach are the theoretical basis, the specific methodology, and technique of work, the way of evaluation who can be treated, the effects of that treatment, as well as the appropriate procedures for acquiring knowledge and skills for successful treatment of psychotherapy.

The issue of defining psychotherapy has been relevant since its beginning and application in treatment, but, up to date, no commonly accepted definition has been established. For this reason, the conceptual definition of psychotherapy also acquires a philosophical dimension, as pointed out by some well-known psychoanalysts (Alexander, 1957).

In the Encyclopedia of Psychiatry, we find the following definition of psychotherapies: "In a broad sense, psychotherapies encompass all methods of treating psychiatric and even somatic disorders by psychological procedures, or, more precisely, by the relationship between therapists and patients (J. Laplanche and J.B. Pontalis) In this sense, psychoanalysis is one form of psychotherapy" (Poro, 1990: 538).

From the beginning of psychotherapy to these days, there have been attempts by several authors to classify groups and forms of psychotherapy, however, up to date, no proposal has become universally accepted.

At the end of this part of the paper, we would list contemporary classifications of psychotherapy as Eric cites them, grouping them into five broad groups: dynamic, cognitive-behavioral, humanistic-existentialist-phenomenological, integrative, and sociotherapy.

Table 1. *Classification of forms of psychotherapy - Lewis Wolberg (Lewis Wolberg, 1970), T.B. Karasu (T.B. Karasu, 1977) and World Alliance for Psychiatry, 1996*

- Dynamic forms
  - Freud's psychoanalysis
  - Cleinian psychoanalysis
  - Ego analysis
  - Neo-Freudian or No-Freudian psychoanalysis
  - Alfred Adler's Individual Psychology
  - Analytical, complex, psychology of Karl Gustav Jung
  - Character analysis or orgone therapy by Wilhelm Reich
- Dynamic Cultural School of Psychoanalysis
  - Karen Horney School
  - Harry Stack Sullivan School
- Existential analysis
- Psychoanalytic Psychotherapy
  - Short Dynamically Oriented Psychotherapy
  - Supportive analytical psychotherapy
  - Group analytic psychotherapy
- Cognitive-behavioral therapies
  - Behavioral therapy
  - Cognitive therapy
  - Cognitive analytic therapy
- Humanistic psychotherapies
  - Family therapy
  - Partner therapy
  - Gestalt therapy
  - Transactional analysis
  - Psychodrama
  - Constructivist psychotherapy
- Integrative psychotherapy
  - Integrative Gestalt psychotherapy
  - Integrative dynamic psychotherapy
  - Integrative cognitive-behavioral therapy
  - Psychosexual therapy
- Sociotherapies
  - Environmental therapy - adaptation to the environment - sociotherapy
  - Occupational, working and recreational therapy
  - Music therapy (therapy with music)
  - Art therapy
  - Therapeutic community (Eric, 2006: 13-14).

Following a general approach to psychotherapy so far, we would devote our further exposure to behavioral therapy, primarily because it has found widespread use in the treatment of individuals with developmental disabilities, as well as learning and behavioral problems.

BEHAVIORAL THERAPY AND ITS APPLICATION IN DEFECTOLOGY

Definition

In the literature dealing with the problem of psychotherapy, we can often find a very broad understanding of behavioral therapy as a theory of learning that has been applied in practice. However, such a definition of behavioral therapy would include other psychotherapeutic directions, for example, cognitive therapy (Tadić et al., 2004).

In the *Encyclopedia of Psychiatry*, apart from the general definition of psychotherapy (discussed above), it is not explicitly provided a definition of behavioral therapy but it is indicated that these therapies "start from saying that maladaptive painful responses are, in fact, learned and that by repeated learning they can be replaced by positive anxiety-free practices" (Poro, 1990: 539).

In our background, Starčević provides the following definition: "Behavioral therapy could be more closely defined as the series of techniques and procedures based on the assumption that a psychiatric disorder is the result of a wrongly learned behavior, and because of that the main goal of treatment is to eliminate such behavior. Simply said, behavioral therapy is engaged in changing behavior for better health" (Starčević, 2006: 285).

Theoretical basis

It is safe to say that behavioral therapy is based on the principles of common sense more than it is constituted as a formal form of treatment. Namely, many prominent figures of the seventeenth and eighteenth centuries, including the English philosopher John Locke (1632-1704), the German poet Johan Goethe (1742-1832), intuitively advocated the implementation of behavioral therapy techniques in certain situations. This attitude was also emphasized by Pierre Janet (1859-1947) and Sigmund Freud at the beginning of the twentieth century, but behavioral techniques gained their ground only with the development of experimental psychology. First of all, the experiments of the Russian physiologist Ivan Pavlov (1849-1936), John Watson (1878-1958) and Barshus Skinner (1904-1990) provided solid foundations for behavioral therapy. A significant influence on the emergence of the first behavioral therapy techniques was made by the theory of Mowrer (O.H. Mowrer, 1939), who defined phobia as the fear that is a product of classical conditioning, which is subsequently maintained by the behavior of avoidance. In other words, avoidance reinforces the phobia in a way that reduces the experience of fear. Based on this, it was concluded that phobia cannot be successfully treated without eliminating avoidance.

The aforementioned Mowrer's theory enabled Joseph Wolpe (Josef Wolpe, 1915-1997) to promote the first behavioral therapy in 1958 by introducing systematic desensitization from which the technique of exposure later emerged. The essence of systematic desensitization is reflected in the removal of learned fear by imaginative exposure to objects and situations that cause fear in circumstances in which experiencing fear is not possible (relaxation). The result of repeated "pairing" of relaxation and exposure to phobic objects and situations is the process of disengagement (desensitization), that is, the appearance of less and less fear as a reaction to a phobic object or situation until the fear disappears, namely until the person learns not to associate the phobic object or situation with fear (Wolpe, 1958).

The aforementioned Wolpe's behavioral therapy technique has been refined and adapted to different patients over time. From the 1960s to the early 1980s, behavioral therapy began to be increasingly applied in the treatment of various phobias and obsessive-compulsive disorders. Significant contributions have been made by some researches that have indicated the success of behavioral techniques in the treatment of these disorders.

The 1980s and 1990s were characterized by the integration of behavioral and cognitive therapy and the development of "hybrid" cognitive-behavioral therapy. This integration is justified and logical for at least two reasons - both are based on the same theories and have the same uses. Although behavioral therapy gives an advantage to the changing of behavior and cognitive therapy advocates changing one's mindset, they do not exclude each other. Besides, it is clear that behavior and the way of thinking go "hand in hand", that is, they influence each other. Also, the practice has shown that in the treatment of many disorders, the cognitive-behavioral approach has had better effects than the "pure" application of one or the other therapy.

In our country, several authors have contributed to the application of behavioral therapy and the education of therapists. Among them are Jezdimir Zdravković (1937-), Slavoljub Radonjić (1932-) and Živorad Kastratović (1941-).

Behavioral therapists have outlined several ways that can lead to fear to be learned: classical (traumatic) conditioning, model learning (imitating or observing others), and transferring information from others.

Classical conditioning was first described by the Russian physiologist Pavlov and is commonly known as a situation in which a certain natural stimulus (food, for example) is followed by a natural, reflexive response (salivation).

The experiment done by Watson and Rayner (Watson & Rayner, 1920) showed that classical conditioning can determine pathological fear and phobia; they provoked fear of white rats in an eleven-month-old baby named Albert, by repeatedly exposing him to a white laboratory rat (conditioned stimulus) simultaneously causing an unpleasant sound (unconditional stimulus) that triggered a fear response (unconditional response). The final consequence was the fear reaction even when the white rat appeared, although the unpleasant sound would be absent. Thus the fear of white rats was learned as their conditional response to the conditional stimulus. In the case presented, the phenomenon of stimulus generalization was also explained because Albert began to fear everything that resembled a white rat (conditional stimulus), such as white rabbits and white fur coats.

Classical conditioning is also called traumatic because a certain traumatic event (as an unconditional stimulus) can be linked to the situation in which it was experienced and which did not cause fear until then.

An occasional reinforcement is required to classical conditioning model which triggered fear in a laboratory to maintain fear, or otherwise, it disappears over time.

Model-based learning involves the emergence of a phobia based on observing or imitating others from one's surroundings. For example, a child may learn to fear an animal or an elevator if the mother is afraid of that.

Also, some fears can be learned through the so-called transfer of information. For example, some children may show fear from some animals if their parents indicate a potential danger from certain animals.

Maintaining phobic fear is explained by operant (instrumental) conditioning. It is directly linked to learning through trial and error. Namely, learning consists of the series of attempts to find a solution to a particular problem or to reach a specific goal. Along the way, mistakes are made, but the behavior that leads to the solution of the problem or the achievement of the goal is reinforced or learned. "Under the operant conditioning model, it is not problematic to support positive and beneficial behavior, but rather to corroborate behavior that only seemingly solves the problem and, in fact, make it even greater. Typical examples of such behavior are avoiding and escaping from phobic situations and performing forced actions. The purpose of these behaviors is to reduce fear, discomfort and / or tension, but such effects maintain fear, discomfort and / or tension at the same time. In this way, the phobia is reinforced, that is, the obsessive-compulsive disorder" (Starčević, 2006: 291).

Objectives

As a primary goal behavioral therapy aims at eliminating symptoms by modifying misconceived behavior. That is why the term behavioral modification is often used. Although behavioral therapy basically do not ignore the other components of symptoms and disorders (cognitive, physical, emotional), it focuses on the behavior that should be changed. Therefore, it is emphasized that: "... the goal of behavioral therapy is to adopt a different, more beneficial behavior as well as to abandon the behavior that characterizes a particular disorder. For example, the first goal of behavioral therapy in the treatment of phobia is to eliminate the fear of certain objects or situations by ceasing to avoid those objects or situations. The next goal is more ambitious because it is about adopting behavior that will protect the person from the patterning of phobia and avoidance" (Starčević, 2006: 292).

Several other goals of behavioral therapy have been rarely highlighted in the literature: to contribute to the responsibility of the patient for his treatment, to allow the patient to rely on himself, and not to make the patient dependent on the therapist.

Indications and contraindications

From the beginning and onwards, behavioral therapy has expanded its indication area, as well as techniques that have been used in almost all forms of psychopathology. Besides, all major achievements in behavioral therapy in working with adults have had relevant impacts on use in working with children and young people.

At this point, further attention will be given to the indicative areas of the application of behavioral therapy in defectology, neglecting some indicative areas in the treatment of the population of typical development.

In the 1960s, behavioral therapy took a significant place in the implementation of work with children within the three main areas. The first area concerns the work with children with intellectual disabilities who were hospitalized in specialized institutions. It is within this field of application that the term behavioral modification is used instead of the term behavioral therapy. The programs implemented within this field of application are aimed at building self-care habits and skills (dressing, eating, use of toilets, use of money), as well as developing social skills. Today, it is emphasized that behavioral therapy has revolutionized the field of skills acquisition and learning of children with intellectual disabilities as well as adults.

The need for the use of psychotherapy in oligophrenology is also emphasized due to the higher incidence of disorders and disabilities in people with intellectual disabilities, which may be due to intellectual disability. Thus, for example, Tadić states: "A fundamental intellectual defect, regardless of its causes and peculiarities of relationships and actions between a child, a young person, a family and the wider community, can cause a higher frequency of disabilities and disorders in the emotional and social development of the group of mentally retarded individuals (Tadić, 1988, 1989). But despite the real need, psychotherapy for the mentally retarded population has long and unjustifiably been neglected and little researched" (Tadić, 2004: 395).

Psychotherapy for people with intellectual disabilities must be part of the overall plan for their treatment, rehabilitation, upbringing, and education. To this end, it is necessary to establish appropriate cooperation among experts of different profiles, as well as to familiarize defectologists with theories on personality development, disorders and the basic principles of psychotherapeutic approach because they work in schools and specialized institutions with this population. It is precisely the association of psychotherapy methods and techniques with educational and rehabilitative approaches that could be called a psychotherapy approach in dealing with a population of people with intellectual disabilities.

Bearing in mind the characteristics of people with intellectual disabilities, the goals of psychotherapy with them cannot be far-reaching and deep, primarily because of their inability to fully and consciously control their internal and physical conflicts, to translate their feelings and aspirations into words and opinions. "The goals of psychotherapy for the retarded population are more modest. It aims to alleviate or eliminate devastating emotional suffering and to free up emotional, conscious and social development within existing and objectively diminished opportunities. Psychotherapy cannot be expected to increase the intelligence, although parents often hope for, but it can be expected that by easing emotional suffering and devastating internal conflicts, at least a part of the energy possibilities will be released and invested in better intellectual functioning" (Tadić, 2004: 397). Certainly, psychotherapy is also needed for parents who have a child with an intellectual disability from the very detection of intellectual disability.

Appropriate contraindications to the use of psychotherapy in oligophrenia are also indicated in the Encyclopedia of Psychiatry: "Thus, in cases of psychoses related to the development of a particular organic disorder, such as infection or intoxication, or some deep disturbance of the psychological structure (primary dementia, for example), or those that represent real and incurable psychiatric defects (oligophrenia, senile dementia, constitutional imbalance), psychotherapy has only partial effects" (Poro, 1990: 540).

Another important area of application of behavioral therapy is the area of educational and school problems. These procedures are more often organized in school and family, and rarely in clinical settings. The pre-arranged procedures are conducted daily by teachers, parents, siblings, classmates with the guidance and constant supervision of a behavioral therapist.

Various psychiatric disorders and problems of children and young people represent the third area of application of behavioral therapy. Within this area, the subject of treatment is most commonly behaviors based on anxiety, phobias and fears, attention disorders and behavior in children with hyperactivity, as well as some isolated symptoms (enuresis, encapsulation). Often, all these go with school failure and learning disabilities or specific reading and / or writing difficulties. In all these cases, behavioral procedures are most commonly implemented to improve motivation to learn, improve attention and concentration for learning and teaching, building independence for teaching and learning, and adopting more effective learning methods. Often, while working with children with learning disabilities, the task of therapy can be elimination of the fear of answering or testing.

In clinical settings, behavioral therapy is used in procedures that aim to eliminate or mitigate behavioral disorders, aggressiveness, or delinquent behavior.

"Psychotherapy as a way of treating children and young people with behavioral disorders is still a subject of discussion among psychiatrists, specialized pedagogues, psychologists, and social workers. Psychoanalysts see this disorder in the light of disturbed objective relations and seek the possibility of successful treatment of such children and young people in the correction of early experiencing of the parent object, which can only be achieved by psychotherapy whose ultimate goal is to enable the child through the introjections of good objects to create a more mature superego and ego-ideals" (Čiček & Nikolić, 2004: 352).

A behavioral model for understanding and eliminating behavioral and experiential disorders emerged in pediatric psychopathology only after many years of domination of the psychodynamic interpretation of these phenomena. There are significant differences between the two models, and they are more reflected in theoretical concepts, while in clinical practice, it is often observed successful completion and collaboration of experts from these two orientations.

When it comes to the use of psychotherapy in typhlology, that is, in people with visual impairments, specific features arise from the peculiarities of their emotional, cognitive and social development, which is described in some works (Lesser, 1979; Popović, 1983; Poznanski, 1979; Tadić & Kraigher, 1980). Due to the disability itself, but also because of inappropriate attitudes of parents, the narrower and wider social environment, the maturity and development of structures and functions of the personality of children and young people with visual impairments are more often endangered and altered compared to children and young people of typical development.

As with persons with intellectual disabilities, psychotherapy must be a part of the overall plan for their treatment, rehabilitation, upbringing, and education, involving parents, the school and the wider community. In this regard, psychotherapy for the visually impaired must have two goals: "preventive (prevention of sensory, cognitive and social disorders of development and promotion of social health) and treatment of already existing disorders and developmental disabilities (transient reactions and difficulties of adjustment, neurotic reactions, conditions and organized neuroses, character disorders, function organization, and psychoses)" (Tadić, 2004: 399).

The psychotherapeutic relationship with the visually impaired people is established, first of all, by speaking through the color of voice, emphasizing and using words that describe the object and expression of the psychotherapist's face, but also by touch, movement, and play. "One of the first goals of psychotherapy is to make a child or a young person to identify, express, and illuminate, within the framework of a positive psychotherapy relationship, his experience of impairment and painful feelings (sadness, dissatisfaction, anxiety, fear, hostility, jealousy, feeling of inferiority) (Cholden, 1961, Adams 1980), the phantasms, defenses (projections, denials, setbacks, and others) and behaviors and thoughts (withdrawal, rivalry, ferocity, vindictiveness, and others) that accompany it" (Tadić, 2004: 401).

The development of psychotherapy as a method and the knowledge spreading about the psychic and psychiatric consequences of deafness were crucial for the use of psychotherapy in hearing-impaired individuals. Therefore, the use of psychotherapy in hearing-impaired individuals was preceded by appropriate researches on the consequences of deafness in psychological and psychiatric terms. The first research into the mental health of hearing-impaired individuals is related to Edna Levine (1956, 1974), who studied the problem of deafness in the 1950s, followed by F. Kalman (1963) who did extensive researches on deafness that provided a good basis for the application of psychotherapy. However, the very beginning of psychotherapy work with this population is related to rehabilitation and certain assistance to hearing-impaired people in living and working in society during and after formal treatment.

People with hearing impairments exhibit the same types of mental illnesses and emotional disturbances as those with normal hearing, however, due to the dominance of the hearing population, these individuals have additional adaptive demands in the surroundings. Specifically, a key problem in the development of a hearing-impaired child is his limited ability to communicate which, with other limitations, makes mental illnesses in this population more difficult to detect and treat.

We must emphasize that there are no specific indications for the use of psychotherapy procedures in children and young people with hearing impairment but that it is the same as for hearing population of the same age, although the hearing impairment itself in certain cases may be an indication for the use of psychotherapy. This is, above all, related to mild hearing impairments, which usually interfere with social contacts and affect the appearance of pronounced adaptive disabilities in these individuals. "However, the position of a deaf child is much different from that of a hearing child. From the moment a hearing impairment is detected, and this is also possible at birth, the deaf child becomes the subject of observation and treatment by a multidisciplinary team in which in most cases everything is focused on the most successful treatment of speech and hearing. Each of these team specialists has his program and the goals he wants to realize. Very often, these professionals act disunited and independently, which seems confusing to the child and creates effects that disrupt the achievement of the goals. The solution is seen in mental hygiene activities whose most effective means is psychotherapy and the type of psychotherapeutic approach should take into account the child's capabilities. The main goal of these activities is to achieve a more harmonious psychic development. This is where psychotherapy occurs as a preventive measure, it is well developed and is connected to rehabilitation institutions" (Stojnić, 2004: 405).

The specificity of psychotherapy in children and young people (including adults) with motor impairments is also pronounced. Namely, bearing in mind the fact that motor disorders are a consequence of a very wide range of clinical diagnoses, it is not possible to base psychotherapy on a single theoretical approach. The type of motor impairment in a particular person determines the way he reacts in the social field, but at the same time influences the creation of attitudes of the social surroundings concerning his reaction. All this has a dialectical effect on how a person with a motor impairment experiences himself.

In the population of children and young people with motor impairment, we most frequently find those with cerebral paralysis, those who have suffered traumatic head injuries, paraplegics, tetraplegics, children with limb amputations, with congenital physical deformities and neuromuscular diseases. All these diagnostic entities result in the most pronounced changes to the motor system. However, consequences are present not only in the development of practical activities but also in the development of cognitive abilities. Also, in the population of individuals with motor impairments, there are associated disorders or multiple disabilities, for example, varying degrees of intellectual disability, visual impairment, etc. Therefore, different types and degrees of motor impairments can lead to certain disorders and disabilities in the development of personality and cognitive development. All of the above also defines psychotherapy approaches that can and should be used in working with the population of individuals with motor impairments. Bearing in mind the close relationship between a child and his parents, the used psychotherapeutic procedures must target both the child with motor impairments and the parents. In some cases, even the psychotherapy of parents may be sufficient to facilitate the life of a child with motor impairments.

"*Preventive counseling with parents* is of great importance in the psychotherapy of physically disabled children, which, of course, presupposes that parents have the opportunity to become involved in it. This means that the parent must be involved in that work as soon as the child's disorder appears. This should be provided immediately for parents of children with cerebral paralysis... *Counseling with parents is based on psychodynamic grounds*. *It can also grow into some form of group activity for self-help*. First of all, parents should be assisted in establishing cooperation and communication with the child, who is so motor-disabled that this cannot be achieved without difficulties. At the same time, they should be allowed to express their fears, anxiety, sorrows, shaken feelings of their adequacy, frustrating narcissism, feelings of guilt" (Lorenčić, 2004: 409).

Behavioral therapy techniques

Although we have outlined some of the techniques used in behavioral therapy during our review of the selected topic, we have dedicated a special chapter to this problem. At the very beginning, it must be emphasized that the implementation of behavioral therapy must be preceded by a detailed behavioral analysis. The primary goals of the behavioral analysis are for the therapist and the patient to identify and understand the specific interactions between the factors that lead to the disorder itself and those that sustain it.

A common feature of almost all behavioral techniques is the records keeping of the details of a therapeutic procedure and certain homework that the patient has to do between therapy sessions (Starčević, 2006).

"The American Psychiatrists Association and some other professional associations have classified the following techniques into recognized behavioral therapy techniques:

1. Systematic desensitization.- The essence of the technique is a) a gradual, b) progressive c) exposure d) to the terrifying circumstances with e) an additional stimulus or condition incompatible with fear;
2. Operant principles.- The essence of the method is: a) the planned rewarding of desired behavior b) the planned denial of reward for unwanted behavior;
3. Aversive control. - The essence of the method is to deny the reward and to use the time out method. The term and manner of applying the "time out" procedure is described in the proposed literature (Anić, 1984);
4. Self-affirmation training. - The essence of the method is to teach the person in treatment to express his will and intentions, to counteract in an inoffensive manner, and to achieve more successful relationships with the social environment and to show more security" (Anić, 2004: 102).

Starčević lists the following behavioral therapy techniques: exposure (exposition), modeling, social skills learning, behavior modification using aversive procedures, stimulus control techniques, chip economics, and other techniques (Starčević, 2006).

Exposure (exposition) is referred to as the most significant, effective, and commonly used behavioral therapy technique, which has already been discussed in the part of the theoretical basics and noted that its theoretical basis is derived from Mowrer's theory according to which the condition for the disappearance of fear is the ending of avoidance. Exposition as a technique is used in many ways, which is conditioned by the form of phobia or fear and the characteristics of the patients. The main differences in the use of exposition relate to whether it is carried out: 1) by imagining or live (in vivo), 2) gradually or abruptly, that is, by flooding, and 3) alone or with the help of a therapist or a partner.

Modeling therapy involves such a behavioral technique in which the patient first observes how the therapist is fearlessly exposed to the phobic object, and, afterward, the patient himself imitates the therapist when ready for it. It is used in the treatment of phobias in children, agoraphobia, less often in obsessive-compulsive disorder.

"Learning social skills involves a variety of techniques aimed at allowing a person to express his feelings freely, to be able to cope with what is important to him, to communicate better and to solve problems more easily, and / or to be able to control his inclination to react impulsively" (Starčević, 2006: 303).

Behavioral modification using aversive procedures is a controversial technique that caused behavioral therapy to be criticized and it is rarely used today. The essence of this technique is to eliminate maladaptive behavior by applying direct or indirect punishment.

Stimuli control as a behavioral technique come down to a series of instructions that are given to influence the change of certain habits. It is most commonly used in the treatment of obesity and insomnia.

“The chip economy was first used as an additional tool in the rehabilitation and re-socialization of chronic, psychotic patients in major mental hospitals. The name of the technique derives from the fact that such patients received chips in exchange for desirable behavior with which they could buy something or use them in another way that suited them” (Starčević, 2006: 305).

Other behavioral techniques include procedures aimed at changing certain actions, habits, and behaviors such as teak, nail-biting, hair pulling, excessive scratching, and thumb sucking in children. All of these actions are based on the replacement of an existing activity or habit with a new one that is incompatible with the previous one and will have an inhibitory effect on it until it is disabled.

Finally, we would emphasize that behavioral therapy techniques are often combined with other procedures (for example, cognitive therapy) and within the indication areas we have discussed.

CONCLUSION

Psychotherapy is an ancient healing skill that took its definitive form in the late nineteenth and early twentieth century when Viennese psychiatrist Sigmund Freud came up with his theory of psychoanalysis, which challenged the exclusive primacy of biological factors in the emergence and treatment of psychological disorders and emphasized the importance of psychological factors. Since its beginning, psychotherapy was exclusively a method of treating neurotic disorders within psychiatry, but over time, its application has become more widespread in all fields of medicine, at all ages, but also in all significant areas of human life: sexuality, marriage, family, academic achievements, work and social success and so on.

The results of numerous studies in the late 20th century confirmed the fact that all mental disorders are a consequence of the interaction of three factors: congenital dispositions, developmental traumas, and social factors and they contributed to the constitution of psychiatry as a scientific discipline.

In addition to the historical approach, the paper discusses the general problems of defining psychotherapy, the theoretical basis and principles of psychotherapy, its goals, indications, and contraindications for its application, classification, and some other general issues. Particular attention in the work is devoted to behavioral therapy and its application in defectology within each of its branches.

It is difficult to predict what further course the application of psychotherapy will have in defectology. Although there are relevant results on the relatively wide use of behavioral-cognitive therapies in working with children and young people (and adults too) with disabilities, the time ahead has to provide more accurate data on their true value, but also about the disadvantages and benefits concerning other approaches. Therefore, it is necessary to build on a more comprehensive theory on the development and elimination of sensory, cognitive and social disabilities based on the results of appropriate research and further knowledge, as well as the treatment of mental disorders in the population with developmental disabilities.

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LONGITUDINAL RESEARCH OF MOTOR DEVELOPMENT - THE POSSIBILITY OF APPLYING DIFFERENT STATISTICAL METHODS

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SUMMARY

Motor development is a very complex process and two research designs are generally used to study it. These are cross-sectional studies and longitudinal studies. Longitudinal researches are very important because they allow us to identify cause and effect relationships between various factors that influence development. Also, by applying such designs, we discover the dynamics of the complexity of those relationships. This paper analyzes longitudinal researches of motor development with a focus on the application of different statistical methods in these studies. Partial research and the use of a statistical method without multifactorial data analysis are not sufficient to define the specificities and factors of motor development in children of typical development and in children with developmental disabilities. The choice of research design, along with the selection of adequate statistical methods and techniques for data processing, are of the exceptional importance, because this will produce valid results.

Key words: study design, statistical methods, longitudinal research, motor development

INTRODUCTION

Different research designs allow defining methods and procedures for collecting and analyzing collected information. Research design is used to create an adequate research structure, but also to prove that all parts of the research design work together (Robson, Shannon, Goldenhar, & Hale, 2001). The classification of research design is almost the same for all scientific disciplines. Choosing a specific design caused by the phenomenon that we are studying. Studying the areas of human development, most research findings are based on studies using a cross-sectional design. The focus of these studies are on the developmental differences between different age groups, and these studies ignore the developmental changes that have occurred in individuals. Most researchers believe that these studies cannot be considered as truly development studies, but changes that occur over time in all aspects of development can only be evaluated by longitudinal studies (McCall, 1977; Wohlwill, 1980, according to Schneider, 1993). When it comes to study of motor development, the available research findings indicate that two research designs are in use. The first represents a cross-sectional research and the second a longitudinal research (Sretenović, Nedović, Eminović, 2018). In order to determine cause and effect relationships between various factors, longitudinal studies are needed to fully address the dynamic complexities in such relationships (Chaddock et al., 2012; Wittberg, Northrup, & Cottrell, 2012).

In this paper, the focus will be on longitudinal research.

When it comes to longitudinal research, there are several problems. The first problem concerns the definition of a longitudinal research. The term *longitudinal research* not only describes a single method, but encompasses a wide variety of methods. "The spectrum of methods ranges from single case studies in time-series arrangements to broad-band panel designs including numerous measurement points and thousands of subjects. The only common denominator of longitudinal research is variation of time and repeated observation of a given entity" (Baltes & Nesselroade, 1979, cited in Schneider, 1993: 317).

Longitudinal refers to designs which aim to determine individual development of functions by the assessment of transitions and changes in performance over relatively long periods of time. Here it does not refer to designs aimed at measuring the improvement of performance over time in, for example, a task with 1000 trials, with time as a natural independent variable (Geuze, 1993). Longitudinal research derive its strength from the possibility of analysing developmental data individually. It depends on the goal of the study whether the data are described in terms of individual development or of group development. The individual data are averaged, not according to a time reference such as chronological age but according to the occurrence of some important transition in development (Geuze, 1993). For example, most experimental studies on clumsiness (Cantell, Smyth, & Ahonen, 1994, 2003; Geuze & Börger, 1993) are based on some model of information processing or movement control. In the processing of task relevant information, this information may be provided externally (for example stimuli) or internally (for example proprioception). The experimental approach is process-oriented. It aims to assess specific functions in information processing that seem to be particularly relevant for motor performance.

Scientific interest in the longitudinal approach to ontogenetic development dates back to the XVIII century (Bakes & Nesselroade, 1979, cited in Hopkinsy, Beek, & Kalverboer, 1993), but it has never really become a consistent feature of research in child development. This state of affairs is hardly surprising as the practical and methodological difficulties associated with longitudinal research on human development constitute a formidable barrier. These difficulties (Fletcher & Satz, 1984) are so numerous and persistent that longitudinal research may easily become a rocky road to disillusionment. However, practical problems are not the only nor even the main reasons for the dearth of longitudinal studies on motor development. In no small measure this is due to the nature of prevalent theoretical persuasions in general and the scarcity of clearly articulated concepts in particular. After all, the first research step required is the formulation of theoretically meaningful questions and not, one hopes, the selection of a methodology. The type of longitudinal methodology employed is to a large extent determined by the nature of developmental theory (Hopkinsy et al., 1993).

In the available literature, it is possible to find the following two categories of longitudinal studies on motor development. One category contains studies whose purpose are to chart and to understand the changes with age of particular normal or abnormal sensorimotor functions. These are called individual-oriented. The other category consists of follow-up studies of groups of children who meet particular selection criteria with the aim of finding long-term relationships between group characteristics. These are called group-oriented studies (Touwen, 1993).

Individual-oriented studies deal with changes with age which are thought to be characteristic of certain sensorimotor functions, with a view to explaining the dynamics of development. Somewhat paradoxically, more emphasis is given to the function studied than to the individuals who display that function. Because intraindividual comparisons of particular sensorimotor performances are made over time, and because an attempt is made to attribute changes in performance to developmental properties of the brain, other variables which may affect the developmental process have also to be taken into consideration. The effect of some of these variables on development is already known or can be guessed, for example in the case of diseases of the brain or of the motor apparatus itself, severe malnutrition or deformities. The effects of such variables can be discarded by excluding the subjects who suffer from them. For other variables the effect is either not known or is speculative, and, more importantly, many of these variables cannot be discarded because they are omnipresent (Touwen, 1993).

The basic goals of longitudinal research concern the description and explanation of human development. There are three reasons for describing development: (1) identification of intra-individual changes, (2) identification of interindividual differences in individual change and (3) identification of interconnections among classes of behaviour during development. The analysis of causes of intraindividual change, the analysis of causes of interindividual differences in intraindividual change and the prediction of individual differences in one domain from individual differences in another domain are goals that represent the explanation of the development. Studies illustrating these categories include, for example, longitudinal projects investigating the impact of early risk factors (domain A) and later motor skills (domain B). These studies are obviously longitudinal in perspective, because the same individuals are tested multiple times, but they do not necessarily include aspects of intraindividual change in a particular variable (Baltes & Nesselroade, 1979, according to Schneider, 1993).

We can say that there is a general agreement in the literature which examining developmental characteristics, that two basic types of longitudinal testing can be used to achieve the above goals (Appelbaurn & McCall, 1983).

The basic aspect of a longitudinal research concerns what Wohlwill (1980, according to Baltes, Reese, & Lipsitt, 1980) called a “developmental function”. This is explained as the average value of the dependent variable plotted over time. Typical examples derived from a longitudinal research of motor development include growth curves that relate to the development of speed or physical strength and show continuity versus discontinuity of these variables over time. Another aspect of longitudinal research concerns the issues of individual difference. More specifically, the question here is whether individual subjects maintain approximately the same relative rank ordering within their group at one age as they do at another (McCall, 1977, according to Magnusson, 2015). The question is how stable or volatile individual differences among individuals have remained over time. It should be borne in mind that the issue of stability versus instability of individual differences over time is conceptually independent of the question of continuity with respect to interruption of developmental function:

for example, it is theoretically possible to follow a monotonous, linear increase in the average dependent variable over time with a high degree of instability of individual differences in this variables. More specifically, the fact that a linear increase in motor coordination ability can be found in pre-school age does not exclude the possibility that individual differences in performance may not be preserved at this time interval. Researchers using the longitudinal approach to studying motor development often overlook the fact that developmental function and the stability of individual differences over time represent two separate aspects of the same problem (Schneider, 1993).

Analysis of intraindividual and individual change during the time - statistical methods

In the late 1980s, it was tried to clarify to the general scientific and professional public the existence of myths accompanying longitudinal research. Misunderstanding of longitudinal studies is based on measures of intra-individual change over time. However, this problem is very easy to solve and explain today, because sophisticated statistical tools are used to analyze intra-individual changes. Interpretation of the results of changes in the group analyzes was not a problem, because the same results were obtained by using analyses of variance as well as by applying analyses of variance based on the results of changes that occurred after testing. The problem, then, was in assessing individual changes, because many researchers thought these results were undesirable and unfair. Methodological papers written in defense of intraindividual differences also support this (Rogosa, 1988). The findings are the result of an unbiased assessment and a real change in the individual.

Most recent advances in the statistical theories of hierarchical linear modeling (HLM) provide an integrated approach for the study of various aspects of the individual change. Bryk & Raudenbush (1987, cited in Schneider, 1993) have presented a model that enables the estimation of growth structure, the testing of the reliability of instruments for measuring initial status and changes over time, investigating correlates of initial status and changes occurring, and testing hypotheses about effects theoretically of relevant variables. This model, more precisely the hierarchical linear model, consists of two phases. In phase 1, the observed developmental changes of each individual were conceived as a function of a single curve or growth trajectory plus random errors. In phase 2, the assumption is that the individual parameters that determine an individual growth curve vary depending on certain characteristics of the individual's background or environment (e.g. gender or social status). Regarding model assumptions, it is important to note that both individual outcomes and growth parameters are normally distributed. To facilitate change measurement, HLM generates a common metric of the results data collected at each measurement point. As modeling the growth curve requires that the result data collected at each time point be measured on a common metric so that changes over time reflect growth rather than changes in the measurement scale. Item response theory is used to calculate the logit function which models the logs of ratios of multinomial probabilities.

The hierarchical linear model has some specificities when it comes to studying motor development. HLM provides an integrated approach based on a two-stage hierarchical model. This approach makes it possible to study the growth structure of an individual and to evaluate the statistical and psychometric properties of growth curve collections. It also allows assessing the adequacy of between-subject models by estimating the reduction in the parameters of unexplained variance (Schneider, 1993).

"In addition, HLM can be used (a) to assess the reliability of measures for studying both entry status and change, (b) for estimating the correlation between entry status and rates of change, and (c) for predicting future individual growth. While HLM requires multiwave data, the approach is quite flexible in that the number and spacing of observations may differ across subjects" (Bryk & Raudenbush, 1987, according to Schneider, 1993: 330).

One of the most important advantages of the HLM programme is that it capitalizes on any strengths in the available data; that is, if the individual growth curve estimates are reliable, HLM will weight them heavily. If the individual growth curve estimates are not reliable, the model will rely more on information from mean growth curves that are conditioned on available background data (Schneider, 1993).

Longitudinal research focusing on individual differences is based primarily on the issue of stability and predictability over time. For many years, regression statistical models have been used to describe and explain the longitudinal stability or lability of individual differences in different domains. The model of multiple regression analysis is usually based on correction coefficients or covariance structures. The aim is to predict individual differences in the observed criterion variables from different predictors, which may consist of identical measures estimated in the earlier period or may represent conceptually different variables. One of the basic problems of this approach is that the basic statistical model assumes the independence of the predictor variables. The predictors used in regression analyzes are often highly correlated. As a consequence, evaluation results are often biased. Another disadvantage of this statistical model is that nothing is known about the possible interrelationships between the predictor variables, as they are all treated as having the same explanatory status (Schneider, 1993).

With the introduction of another regression approach, the so-called structural equation modeling (SEM) procedure, which uses latent variables, there have been significant changes in longitudinal studies of motor development (Schneider, 1986 according to Schneider, 1993). Computer programs based on this model have existed since the 1970s (say the Linear Structural Equation Model developed by Jöreskog & Sörbom). Causal modeling and SEM techniques have been used by a growing number of scientists involved in the study of human development and developmental change.

A typical feature of all SEM techniques that use latent variables is the difference between a measurement model and a structural model. While the measurement model defines the relationships between the observed variables and the unmeasured hypothetical constructs that represent the observed variables, the structural equation model (i.e., the causal development model) is used to specify cause and effect relationships among the latent variables. For this reason, the factor analytic approach is used to create latent variables, while the regression approach is used to analyze the structural relationships among latent variables. As the general interest is more in the causal / structural relationships among the theoretical constructs than in the relationships between the erroneous observed variables, the logic behind the difference used in SEM procedures makes a lot of sense. Although SEM techniques that use latent variables can be applied primarily to cross-sectional data, they seem particularly promising when used with longitudinal data (Schneider, 1993). Many authors highlights the following advantages of SEM over traditional regression analysis:

- Verbal theory must be reformulated into a mathematical model that can be evaluated;
- Causal relationships are assessed at the level of theoretical constructs;
- The difference between a measurement model describing the relationships between the observed variables and a structural model describing the interrelationships between theoretical constructs also allows a separate estimation of the measurement errors in the observed errors and the specification errors in the structural part of the model: large specification errors usually indicate that the causal model is not in fully listed and missing theoretically important predictive variables;
- It is possible to distinguish between reliability of measured variables and stability of structural relationships;
- There are several so-called suitability tests that reveal the degree of fit between the causal model and the data to which it applies. Causal models are said to be validated when the goodness-of-fit parameter fits the model between data and data that is better than chance;
- Identical structural models can be specified for different samples (e.g. different age groups or children at risk compared to normal samples) to test the generalization of a given theoretical model;
- Although SEM procedures mainly work on correlation or covariance matrices, intermediate structures can also be considered. This means that in the case of multiple comparisons, the relative mean values in the latent variables over time can also be estimated (Beran & Violato, 2010; Schneider, 1993; Tarka, 2018).

There seems to be widespread agreement that SEM procedures are powerful general tools for analyzing longitudinal data. It seems particularly appropriate in large-scale longitudinal studies of motor development that operate on large sample sizes where researchers typically struggle with a large number of variables estimated at different time intervals. As noted above, the SEM approach incorporates the characteristics of traditional regression approaches but is clearly superior due to its flexibility. This is demanding because researchers are forced to refine their verbal theories and translate them into appropriate statistical models. It is not only possible to evaluate causal models, but to test them; that is, to evaluate their data adequacy. Moreover, the coefficients of convenience for competing causal models can be directly compared. Several problems with SEM procedures have been discussed in the literature (e.g. Alwin, 1988; Martin, 1987; Rogosa, 1988). The availability of these techniques offers great potential for abuse. As pointed out by Alwin (1988), in the absence of a well-defined set of theoretical assumptions, in the absence of valid indicators of theoretical assumptions, in the absence of valid indicators of theoretical constructs, or in the absence of a careful set in the measurement process, these methods can lead to meaningless conclusions, which gives a false impression of importance. This represents one of the major difficulties for a responsible researcher using SEM techniques to evaluate this risk.

HLM and SEM procedures have a wide range of applicability in longitudinal studies that address different aspects of motor development.

Application of statistical methods in longitudinal studies

Connolli & Dalgleish (1989) conducted the study that presents a microanalytical longitudinal approach that focuses on issues of intraindividual change. It contains an interesting, detailed description of the development of spoon use skills in four newborns. In their view, the adequacy of nomothetic developmental approaches to assessing the “average” child is questionable, because aggregate data on all subjects is unclear as to the underlying processes of change. This is the phenomenon that different individuals may take different paths to reach the same endpoint of development. Therefore, the emphasis in this study is on individual development. For each child, information about the various behavioral categories was obtained at an interval of about half a year. These authors decided to analyze the data separately for each child using orthogonal polynomials. This trend analysis approach is well suited for analyzing individual case data because it provides a description of the best fit curve (linear, quadratic, or cubic) for the data. The case analysis approach presented by Connolli & Dalgleish (1989) seems appropriate to describe individual changes over time. However, its most obvious limitation is that the results are difficult - if not impossible - to generate among subjects. Consequently, information on the representativeness of the findings cannot be obtained. This dilemma is solved with the HLM approach because the nomothetic and ideographic dimensions can be combined due to the two-stage characteristic of the model.

As discussed earlier, studies addressing the implications of early risk for later motor development are usually based on large samples of subjects and variables and usually last for several years. As a consequence, they represent potential candidates for the SEM approach. In the study by Largo, Kundu, & Thun-Hohenstein (1993), the primary objective concerned the description of motor development, with a particular focus on issues of variability and stability in normal development, as well as the impact of several pre- and perinatal risk factors on later motor development. This study used data from two samples of about 100 premature births and 100 full-term children to represent the developmental course from birth to school entry. Neurological and motor development during the first two years of life were repeatedly evaluated and minor birth defects were measured at age 5. Furthermore, data representing neurological assessment were collected when children were 4 and 6 years old. It appears that both HLM and SEM procedures can be used in future analyzes of this data. HLM analyzes should be limited to the first two years of the study, where information on neurological and motor development is particularly abundant; that is, based on a total of seven measurement points. SEM models can be applied to link motor and neurological development in the range of 0 to 6 years. Information on pre-, peri-, and postnatal factors can be used to predict minor congenital anomalies. Given that the sample size of each subgroup is not particularly large, infant and child birth data can be aggregated, and the dummy risk variable can be introduced into the model as an explanatory factor. SEM approaches could take this advantage by comparing the structural characteristics of motor development for patterns traced through different decades of this century. Such comparisons of models involving different age groups can provide valuable information about the generality or universality of the findings.

For the one more study, the sample size does not cause problems with SEM procedures. The risk group in this longitudinal study included more than 850 children from birth to the age of nine. In addition, a smaller group of children with typical development was available. Comprehensive assessments were made when children were 5 years old, including tests of intelligence and language skills, concentrations, as well as gross and fine motor performance. Assessments at the age of 9 focused on neurological examinations, including various fine and coarse motor functions, and a comprehensive test for motor impairment. In addition, tests of intelligence, language proficiency, and reading and spelling were performed at that particular age. The authors attempted to explain the results in five criterion achievement (i.e., neurological assessment, motor function, language skill, intelligence, and schoolwork) using logistic regression analysis as a statistical tool. Although this tool is in principle suitable for the type of prediction model inherent in the study design, it is of limited value since it operates on the observed variables and cannot consider more than one dependent variable at a time. The advantages of SEM models seem immediate: (a) the difference between theoretical constructs and the observed variables representing these constructs could lead to a considerable reduction in the (latent) variables involved in structural equation models; (b) a structural equation model can be specified that simultaneously includes all five areas of the criterion, thus allowing the different effects of early risk factors to be assessed on different outcome domains; (c) the same structural equation model can be specified for different risk groups. Based on such an approach, multiple group comparisons can be made to investigate whether different risk groups are the same cause model (Michelsson & Lindahl, 1993).

INSTEAD OF CONCLUSION

In short, this brief illustration of possible applications of the HLM and SEM approaches in the field of motor development has shown that the two procedures can be useful when it comes to explaining normal and abnormal motor performance. This does not imply, however, that these approaches should be conceived as “perfect solution”. Certainly, they cannot make up for poor quality data, careless operationalization of major structures and inappropriate design.

Longitudinal studies are important to fully understand the process of motor development during childhood and how risk factors present at this time affect motor development outcomes. However, there is still little research like this.

To better understand and unravel the independent effects of growth and motor performance, longitudinal study designs are required.

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THEORY OF LEV VYGOTSKY AS A FRAMEWORK FOR INCLUSIVE EDUCATION RESEARCH

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SUMMARY

Inclusive education practices are gaining in prominence in educational polices of many countries during the last decades since the Salamanca Statement in 1994. Parallel with that trend, a research field on factors contributing to inclusive education and its outcomes is expanding. However, this research field often lacks theoretical grounding. Theory of Lev Vygotsky is among theories of human development that has been mostly employed in this field of study. In the present chapter we review theoretical and empirical works that used theory of Vygotsky in the study of inclusive education. Next, we present findings of studies on the outcomes of inclusive education for students with special needs and for typically developing students in terms of academic achievement and development. Further, we relate the findings of these studies to the theory of Vygotsky. The review shows that theory of Vygotsky has been fruitful for investigating inclusive practice processes within a classroom. Further, it shows that lack of theoretical foundation of research on inclusive education which is characteristic for majority of studies in the field impairs meaningful interpretations of often inconsistent results. Further implementations of Vygotsky's theory would contribute to the development of this research field, and this, in turn, would contribute to further improvements in inclusive practice.

Key words: inclusive practice, theory of Lev Vygotsky, sociohistorical theory, children with special educational needs, typically developing children

INTRODUCTION

During the last decades, a trend towards inclusive education has been present in many countries worldwide. Inclusive education is seen as an element of inclusive society and is defined as "a process of addressing and responding to the diversity of needs of all learners through increasing participation in learning, cultures and communities, and reducing exclusion within and from education. It involves changes and modifications in content, approaches, structures and strategies, with a common vision which covers all children of the appropriate age range and a conviction that it is the responsibility of the regular system to educate all children" (UNESCO, 2005, p. 13). Inclusive education principles are conceptualized as being congruent with human rights which have been promoted in several United Nations declarations beginning with the Universal Declaration of Human Rights in 1948 (UN General Assembly, 1948). Among these declarations, the Salamanca Statement & Framework for Action on Special Needs Education (UNESCO, 1994) was the first with the explicit focus on promotion of inclusive education. It was adopted by representatives of ninety two countries in 1994, and has influenced education policy of many countries during the last decades, as stated in 2019: “Since 1994, the Salamanca Conference has been the most important reference for public policies and social debates on special educational needs in most countries of the world. Today, it continues to guide the agenda of national and international inclusive policies” (Álvaro Marchesi, cited in Ainscow, Slee & Best, 2019, p. 674).

In the Salamanca Statement, principles of inclusive education have been derived from the framework of human rights. Further, the statement suggests the importance of empirical research, especially action research, and providing examples of good practice, for the promotion of practice of inclusive education. Indeed, since the introduction of inclusive educational trends in education policies of many countries a research field has began to expand focusing on effects of inclusive education on curriculum achievement, and cognitive and socio-emotional development of children and students. Paul and Ward (1996) distinguish two broad paradigms that guide theoretical and empirical research on inclusive education: the ethics paradigm and the comparison paradigm. The proponents of the ethics paradigm regard inclusive education as an ethical issue. They postulate that, in accordance with human rights view, it is ethically right to include children with special needs in mainstream schools. In their theoretical and empirical endeavors they aim to define factors which contribute to successful inclusive education, i.e. to positive outcomes of all students, both with disabilities and typically developing, within the mainstream education. According to our view, Salamanca Statement is derived from the ethics paradigm. On the other hand, the comparison paradigm orients research (mostly quantitative in nature) towards determining whether inclusive education settings or self-contained education settings are related to more positive outcomes in students.

The research on inclusive education within the comparison paradigm is expanding but at a slow rate. Furthermore, the research within the field often lacks theoretical grounds, i.e. it is oriented toward measuring outcomes of inclusive versus separated education without referring to theory/theories on which the research aims and questions are formulated and results interpreted. On the other hand, there are theoretical works which relate some of the prominent theories in field of developmental psychology to the problem of inclusive education.

The aim of the present paper is to consider the application of theory of Lev Vygotsky to the investigation of inclusive education. With that aim, we first review theoretical papers in which theory of Lev Vygotsky is applied to inclusive education. Next, we review empirical papers on inclusive education which used theory of Vygotsky as a framework. Next, we will present empirical findings on the outcomes of inclusive education that haven’t been grounded in the theory of Vygotsky, and we will relate them to that theory. The studies which are included in the review were searched for using Ebsco host in the following databases: Ebook Academic Collection (EBSCOhost), Academic Search Premier, Eric and Masterfile Premier[a]. Also, some works were included in this review, which are not contained in those databases but we learnt of them through unsystematic literature search. For theoretical works, we used no limit regarding the time of publication. Regarding empirical works, we didn’t include articles published before 1995, because we assumed that, due to socio-cultural changes over time, the

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[a] In the review, the papers in English or French language are included. There were no papers in other languages, except a few articles in Russian, which could not be included because the authors of the chapter have no command of Russian language.

relevance of older studies for contemporary inclusive practice may be questioned. Since the Salamanca Statement in 1994 marked the beginning of intensified efforts towards inclusive education in many countries, we decided that the time period after it would be relevant for contemporary inclusion practice.

Theoretical works on implications of theory of Lev C. Vygotsky for Inclusive Education

The review of the literature shows that socio-cultural-historical theory of Lev S. Vygotsky was considered as relevant for inclusive education in several theoretical works. Indeed, Vygotsky himself provided some remarks on the inclusion of pupils with disabilities into mainstream schools. According to Gindis, “Vygotsky was equally critical of what he called the “unlawful segregation” of the disabled and “mindless mainstreaming” of children with special needs“ (Gindis, 1999, p. 338). We will first briefly present some of the basic principles of the Vygotsky’s theory of human development, and then we will turn to works in which the his theory is related to theoretical and empirical investigations of inclusive education.

For Vygotsky, the fundamental characteristic of psychological development is its embededness within the social and cultural millieu. According to Wertsch (1985) the core of Vygotsky’s theory is based on the three principles: a reliance on developmental method; the claim that an individual’s higher mental processes originate from social processes; and the claim that in order to understand mental processes, we must understand tools and signs that mediate them. Vygotsky makes a distinction between biological and cultural development. While biological development is common to humans and other animals, cultural development is distinctively human. The mechanism of cultural development is internalization of cultural tools and signs which occurs in the interaction between a child and adults who transmit to the child signs and tools as cultural achievements. Thus, social interaction is the crucial process through which a child develops so called “higher psychological functions“, i.e. functions which are mediated by signs, such as reasoning, voluntary attention, voluntary memory etc. The most important mediator of higher mental functions is language as a comprehensive, conventional system of signs. Doolittle Vygotsky conceptualized cognitive development as a form of enculturation, or internalization of culture.

One of the core notions in the theory of Lev Vygotsky is the zone of proximal development. The notion is relevant both for teaching/education and for assessment of cognitive development. This notion has been most empirically investigated among the concepts from Vygotsky’s theory. Vygotsky explained the zone of proximal development in one of his works in the following way: “The child is able to copy a series of actions which surpass his or her own capacities, but only within limits. By means of copying, the child is able to perform much better when together with and guided by adults than when left alone, and can do so with understanding and independently. The difference between the level of solved tasks that can be performed with adult guidance and help and the level of independently solved tasks is the zone of proximal development” (Vygotsky, 1982, according to Hedegaard, 1996, pp. 171-172). Thus, for social interaction to be conducive to acquisition of knowledge and to cognitive development, it is necessary that it occurs at the level that is higher, but not much higher, than the actual level of cognitive functioning of the child, i.e. in the zone of proximal development. If social interaction were below the level of a child's immediate potential for further development, it would not promote its cognitive development. Likewise, if it were far beyond the child's potential for development in the actual moment, it could not "pull" child's cognition toward a higher level. The zone of proximal development can be operationalized as a distance between a child's mastery of a problem in cooperation with an adult or a more skillful or knowledgeable peer, and his unaided mastery of that problem. This meaning of zone of proximal development is relevant for dynamic assessment of psychological development and prediction of developmental potentials of a child.

According to Lave and Wenger (1996), the zone of proximal development has acquired three possible meanings from scholars interpreting Vygotsky's work. The first is the already presented interpretation which the authors denote as a "scaffolding" interpretation which has been most closely related to educational practice. The second is a "cultural" interpretation of the zone of proximal development as the distance between the cultural knowledge provided by the sociohistorical context and the everyday experience of individuals. The third, "collectivist", or "societal" interpretation views zone of proximal development as the distance between the everyday actions of the individuals and the historically new forms of the societal activity that can be collectively generated as a solution to the problems inherent in everyday life (Engeström 1987, according to Lave and Wenger, 1996). These three meanings of the zone of proximal development differ in the level of socio-cultural context that is seen as a factor of potential development of individuals. In the "scaffolding" meaning, that is the level of a direct interaction between persons in educational context, in the "cultural" interpretation it is the level of the broad sociohistorical context and possibilities that it provides for the development of individuals, whereas the "societal" interpretation includes historically new solutions and achievements that are born within society and that can be potentially internalized by individuals.

In numerous writings, Vygotsky dealt with problems of development and education of children with special needs. This was also the domain of his professional engagement. At the Moscow Institute of Psychology, he was the head of the section for the education of children who were physically disabled and of children with mental disability and he established a laboratory for the study of development of children with disability (Vygodskaya, 1999).

According to Vygotsky, cultural development of children with special needs is fundamentally identical to development of typically developing children. Whereas children may suffer in their biological development due to the impairment of some perceptive or motor functions, their cultural development, like in other children, is oriented toward enculturation, i.e. towards appropriation of cultural signs which, when internalized, provide a basis for higher mental functions in individual. The difference between children with and without special needs is in types of cultural sign systems which provide a basis for their higher mental functions. That is, children and adults with some form of impairment use specific cultural sign systems which were developed to be used depending on intact abilities, for example Braille alphabet for persons with visual impairments, or sign language for persons with auditory impairments. Further, Vygotsky points that "handicap" does not ensue from the biological impairment per se, but from social responses to those impairments. Seeing in a person with some form of impairment only that impairment, without recognizing other potentials of the person, is the crucial problem of social and educational orientation towards children with disabilities which creates a "secondary defect".

Concerning the adequate educational setting for pupils with special needs, Vygotsky advocated their schooling within the mainstream schools. For example, he writes the following about schooling of children with blindness: "We shouldn't think about how, as early as possible, to isolate and exclude blind children from the life, but about how to include them in the life as early and as directly as possible. A blind child will have to live together with those who see, and because of that it should also learn in common school"[b] (Vigotski, 1996a, p. 64).

In her presentation of Vygotsky's views on education of children with special needs, Gindis (1999) points that he stresses the importance of employment of modified educational methods that are appropriate to compensate for pupils' particular disability. In the education of children with disabilities adapted modes of interaction and systems of signs as mediators are used in order to provide an alternative way of cultural development of a child. However, in order to cope with the problem of secondary handicap, which is not direct consequence of a disability, but is mediated through social attitudes toward a child, children should be included in mainstream socio-cultural context and mainstream schools as a part of that milieu. Gindis (1999) summarises Vygotsky's ideas on education of children with special needs as requiring specially trained teachers, an adapted curriculum, special technological auxiliary means and more time to learn. In a presentation of the contributions of Russian scholars from the early twentieth century to problems of inclusive education, Vygotsky's views on the need of a safe educational environment adapted to a child's characteristics is also highlighted (Akhmetova, Chelnokova, & Morozova, 2017). Gindis (1999) poses the question on how realistically these requirements can be met within a general classroom setting.

Besides regarding the possibilities to meet requirements for adapted educational methods, inclusive and segregated schooling of children with special needs differ in one more crucial point, and that is the peer group context. Whereas in segregated contexts, a peer group consists of children with the same type of impairments, an inclusive school setting includes a peer group of children with various developmental characteristics. Gindis (1999) points that according to Vygotsky, and further elaborations of his ideas by other scholars, a peer group is an important context of child development. In a paper "The role of collective in the development of a handicapped child" Vygotsky points to the natural tendencies of children to relate to children who are at a higher level of competence and suggests that social interaction between children of various levels and kinds of competencies (for example children with visual impairments and children who see) may lead to cognitive development in less competent children. Further, he agrees with Piaget that exchange of opinions between children who may hold different viewpoints in a form of providing arguments and proofs for one's own opinion and challenging opinions of another child contribute to development of reasoning in children (Vigotski, 1996).

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[b] Translation by the authors of this chapter from a Serbian translation of Vygotsky's work.

When considering implications of Vygotsky's theory for inclusive education, Ivić (2014) starts from two crucial notions of that theory: the notion of cultural tools which support human mental powers and the notion of social interaction. Based on Vygotsky's understanding of the role of cultural and psychological tools in the cognitive functioning and cognitive development, Ivić suggests that one worthwhile area of scientific investigation would be to conduct an inventory of cultural and psychological tools which are available to pupils with specific impairments in inclusive setting as well as an inventory of those which can't be used by them due to their impairment. Next, attempts should be undertaken to determine the ways in which missing cultural and psychological tools could be compensated for, and "how a social and cultural infrastructure can be enriched as the bases for mental functioning of persons with developmental difficulties and for inclusive education" (Ivić, 2014, pp. 71-72).

Following Vygotsky's ideas on social interaction, and on didactic interaction as a special form of social interaction, Ivić (2014) points to three components of didactic interaction that take place in the classroom: didactic interaction between a teacher and a pupil, didactic interaction between pupils themselves, and didactic interaction between a pupil and products of culture cultural. The last of the three components was never elaborated by Vygotsky but is inherent to his theory according to Ivić who has called it "cultural interaction".

Didactic interaction between teachers and pupils is a form of asymmetrical social interaction, which may be a formative factor of child's development if it takes place in the zone of proximal development of a child according to Vygotsky's theory. Teachers bring to this interaction cultural tools, and knowledge and skills shaped by a culture which are interiorized by the child. Regarding inclusive education, Ivić stresses the importance of assuring participation of all pupils in didactic interactions with teacher, which depends on professional competence of a teacher. That is, teachers should organize classroom work in such a way that there is enough didactic interaction between teacher and each pupil within his/her zone of proximal development, because only in that way school achievement of all pupils would not be jeopardized.

The second form of didactic interaction which takes place in an inclusive classroom according to Ivić (2014) is didactic interaction between pupils themselves. Ivić also analyses social interaction between pupils which is not embedded in learning situations, but occurs outside these situations. The latter form of interaction may be beneficial for all pupils in an inclusive setting. Children without disabilities develop acceptance of differences and solidarity, while for children with disabilities this interaction brings reduction of social isolation. However, for the effects of social interaction with peers in an inclusive setting to be positive for all pupils in the sphere of their social development, Ivić points to the importance of eliminating the possibility of discrimination and exclusion of children with disabilities.

When analyzing didactic interaction between pupils in an inclusive classroom, Ivić (2014) points that this interaction may differ depending on specific impairments and type of learning activity. In situations in which pupil's levels of competences do not differ largely, independently of whether they have disabilities or not, didactic interaction between pupils may be fruitful, based on exchange of different experiences. However, Ivić points to some problems which may arise in learning situations in which there is a gap between competencies of children with special needs and other children. In these cases, although children with disabilities may benefit in terms of cognitive development and acquisition of knowledge through didactic interaction with more competent peers, cognitive development and school achievement of children without disabilities may be endangered. Also, Ivić points to the potential problem of a dominating attitude of children without disabilities toward peers with disabilities during their didactic interaction which may lead to marginalization and passivity in children with disability.

Empirical research on inclusive education and theory of Lev Vygotsky

Our search of the literature yielded two empirical studies on inclusive education which employed Vygotsky's theory as a framework. In their action-oriented study on collaborative work within inclusive classroom, César and Santos (2006) explored the following issues using ethnographic method: inclusivity in students' talk during collaborative work within mathematics classes; contribution of collaborative work with peers to appropriation of mathematical knowledge and to the development of higher mental functions; the role of the didactic contract (which defines mutual expectations of those involved in collaborative work) in the promotion of knowledge appropriation; and whether there is an impact of working collaboratively with peers over several school years on students' identities and life projects. Based on the obtained data, the authors conclude that collaborative work had beneficial effects for all students. A student with special educational needs showed the following advancements over time: his self-esteem and mathematics performance improved, as well as his comptenece to follow the strategy of solving problems of his group, and his motivation to be a legitimate participant of his classroom's learning community, i. e. motivation to accept responsibility, work hard and know how to interact with different peers have also increased. Pupils without special educational needs through collaborative work with their peer with special educational needs also developed their social and cognitive competencies. For example, one student reports that her undesrtanding of social settings and interactions, and her power to change them increaesed over time. The authors conclude that collaborative work in an inclusive setting contributed to the development of cognitive, and social competencies, and to affective changes such as more respect and acceptance towards diversity in all pupils.

In an also ethnographic study on an example of a good inclusive practice of a primary school teacher in Norway, Flem, Moen and Gudmundsdottir (2004) employed the sociocultural theoretical framework developed by Vygotsky and his followers, among others Bakhtin, Tharp and Gallimore (1988). The main themes the authors concentreted on, in understanding the learning preocesses within the inclusive classroom, are cognitive learning processes and social learning processes. They also investigated collaboration processes between teacher and other school and community professionals involved in the process of education in the school. Starting from Vygotsky's concept of the zone of proximal development, and the concept of scaffolding which refers to processes underlying acquisition of knowledge and competences within the zone of proximal development (Tharp & Gallimore, 1988), the authors analysed how interaction between teacher and pupils made a foundation for children's cognitive and social development. Scaffolding of pupils' learning by the teacher consisted of modelling, contingency management, providing feedback, and instruction related to questions and cognitive structuring. The study provides examples of cognitive and social interaction within the classroom in which the authors recognized developmental process from other-regulation to self-regulation, which is also an important concept of Vygotsky's theory. That is, initially the teacher structures an activity, and subsequently pupils undertake more and more responsibility and internalize the processes of regulation, i.e. they develop self-regulation. The two presented studies exemplify how the theory of Vygotksy and its further elaborations within sociocultural theoretical framework may be fruitful for understanding inclusive education teaching/learning processes.

In the following, we will review empirical studies on the effects of inclusive education on school achievement and cognitive development of primary and secondary school pupils with and without disabilities and we will relate their findings to Vygotsky's theory of psychological development. We decided to focus on academic achievement and cognitive developemnt because acquisition of knowledge and cognitive development are at the core of Vygotsky's theory.

Studies on the effects of inclusive education on academic achievement and cognitive development of children with special educational needs

Studies comparing academic achievement of pupils with special needs in segragated and general aducational schools have yielded mixed results: while some of them suggest positive effects of inclusive education, others suggest no clear-cut differences between the two educational settings in terms of academic achievement of pupils.

Positive effects of inclusive education were established in two studies from Norway and one study from USA omn middle school students. In a Norwegian longitudinal study following pupils with special educational needs during upper secondary school education, it was shown that students in special classes had lower school achievement than students in ordinary classes. Moreover, an increase in the amount of special education for students with special needs in ordinary classes showed a negative effect on their achievement (Markussen, 2004). One more study of secondary upper students in Norway also suggests positive effects of inclusive education for pupils with special educational needs: pupils who were thaught in ordinary classes during first year of upper secondary education, showed better academic achievement over time than pupils who were thaugh in segragated groups. However, the results are not completely in favour of inclusive education, because the latter group of pupils had a higher drop-out rate (Myklebust, 2002). Rea, McLaughlin and Walther-Thomas (2002) compared two groups of 8th grade middle school students with learning disabilities, who did not significantly differ in educational history, socioeconomic status and intelligence quotient, attending inclusive and pull-out educational programs in two suburban schools in USA. In inclusive program pupils received special education support within general classroom, while in the pull-out program students received special education outside the general classroom during some of the classes, i.e. they missed some of the general education classes. Pupils in inclusive program had higher grades than pupils in pull-out program in all school subjects (language, arts, science, mathematics, and social sciences), and they outperformed them or had comparable results on standardized tests of academic achievement in various subjects.

In a Dutch representative sample of primary school pupils mostly no differences were established in terms of academic achievement and non-verbal intelligence between pupils with special educational needs attending inclusive education and two types of special schools: schools for students with learning and behavioral difficulties, and schools for mildly mentally retarded children (Karsten, Peetsma, Roeleveld, & Vergeer, 2001). There was an indication that pupils in inclusive schools made more progress in mathematics over time than pupils in special education for students with learning and behavioral difficulties. Further, it was shown that it both types of education, the number of pupils who showed improvement was comparable to number of pupils who showed deterioration in functioning over time.

A review of studies by Ruijs and Peetsma (2009) showed neutral to positive effects of inclusive education on academic achievement of pupils with special needs. Similarly, but with more caution, Lindsay (2007) in another review study concludes that the reviewed evidence does not clearly support positive effects of inclusion, because a small number of studies which addressed effectiveness yielded marginally positive effects of inclusive education.

Studies on the effects of inclusive education on academic achievement and cognitive development of children without special educational needs

Several studies established that inclusion of pupils with special educational needs in general schools does not affect academic achievement of typically developing students. Demeris, Childs and Jordan (2007) report that the number of students with special needs in grade-3 classrooms is slightly positively, but significantly correlated with average class achievement scores in reading, writing and mathematics. The authors conclude that inclusive education has no negative impact on achievement of typically developing pupils. Huber, Rosenfeld and Fiorello (2001) report that inclusion of pupils with various types of disabilities did not affect academic achievement in reading and mathematics of pupils without disabilities. Ruijs, Veen and Peetsma (2010) report based on a representative sample of primary school pupils in Netherlands that pupils without special education needs in inclusive classrooms do not differ in terms of achievement in language and arithmetic from children in non-inclusive classrooms.

There are studies which report some negative effects of inclusion on academic achievement of students without special needs. For example, Dyson et al., (2004) report a very small negative relationship between inclusion and achievement at the school level with the relationship being more pronounced in secondary than in primary schools. However, the authors assume that the stated relationship is not of a causal nature. Huber, Rosenfeld and Fiorello (2001) established that among students without special educational needs those who had lower academic skills before implementation of inclusive practices benefited from these practices while the achievement of students with higher skills was deteriorated with the implementation of inclusion. Also, this study found that over two years of inclusive practice, reading scores dropped, while math scores increased on average.

A review of twenty six studies by Kalambouka, Farrell, Dyson and Kaplan (2005, according to Demeris, Childs & Jordan, 2007) showed that a slightly more than a half of studies indicated no effect of inclusion on academic achievement and psychosocial functioning of students without special educational needs, while other studies reported either positive, or negative, or mixed effect. This inconsistency of results can, among other factors, be explained by the fact that there are many types of inclusive practices which may differ in their effects.

Theory of Vygotsky and studies on the effects of inclusive education

The reviewed studies on the effects of inclusive education relatively rarely explored the processes of teaching and learning within the inclusive settings. Studies which analysed those processes consistently suggest that differentiated approach to students is beneficial for academic achievement of all pupils (e. g. Demeris, Childs & Jordan, 2007; Dyson et al., 2004). This may be related to Vygotsky's claims on the im,portance of social interaction within the zone of proximal development for cognitive development. This can also provide the explanation for the negative impact of inclusive practices on achievement of students without special educational needs with higher academic competencies (Huber, Rosenfeld and Fiorello, 2001). We assume that studying processes within the framework of theory of Vygotsky would help to resolve at least some inconsistencies in findings on effects of inclusive education.

CONCLUSION

Among theories of psychological development, theory of Lev Vygotsky was the most employed in the study of inclusive education. However, the potential of the theory can be much more utilized in this field of study. Lindsay (2007) pointed out that majority of studies in the field haven't investigated more refined measures of inclusive practices such as classroom processes, resources and curricula. Vygotsky's theory provides a rich framework for future investigation of these questions.

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HANDWRITING SPEED STUDENTS OF LOWER GRADES OF ELEMENTARY SCHOOL

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SUMMARY

Writing as one of the most complex human activities is the ability to properly graphic formatting of letters, the quality of which is viewed through the speed of writing and the legibility of written text. The main aim of this research is to investigate the writing speed of elementary school students. The survey was conducted in Belgrade, 2016 in eight elementary schools. The sample of research was formed from 1156 elementary school students, students from I to IV grade. The McMaster Handwriting Assessment Protocol was used as the measuring instrument. The obtained data show that the average writing speed of the students of lower grades of elementary school is the highest in the writing task to mind (40.86 letters per minute) and the lowest when the text is transcribed from a longer distance (36.31 letters per minute). Consequently, there is a difference in the average writing speed of the students in the classroom, with respect to the class of students, with a significant effect of the type of task on the writing speed (F (2.778, 3208.02) = 466.34, p = 0.000). The speed of writing increases with age, that is, with class, both on individual and total tasks. Inadequate writing speed, when looking at average speed on all four tasks, occurs in 78 (6.7%) students. Since most of the school activities are based on the writing process, and the existing results show that a number of students face a problem of writing speed, special attention must be paid to the adaptation of the educational process to these students. In addition to the difficulty of achieving a satisfactory writing speed, these students very often achieve worse school achievement, so this problem may also affect the emotional aspects of the students.

Key words: elementary school, handwriting speed, school success, student, writing difficulties

INTRODUCTION

Going to school is a very important period in the development of every child. The new environment, the new organization of day and time, and the new activities that form the basis for mastering the teaching material, are the challenges that each student faces when entering the first grade of elementary school. Writing is one of the main tasks that students master in the lower grades of elementary school, and students are expected to master writing of a certain quality, defined through the speed of writing and the legibility of written text. It is defined as "the ability to copy letters or numbers in a particular time and form" (Ashiani, Havayi, Toozandehjani, 2014: 1681).

Many students experience difficulties in writing during their education, manifested by difficulties in writing speed, difficulty in readability the written text, or very often associated difficulties. Research shows that the number of students with writing disabilities varies from researcher to researcher, but in the professional and scientific literature, the most common prevalence is varies on average between 6% and 12% children of elementary school (Berninger, Mizokawa, & Bragg, 1991; Maeland, 1992; Overvelde & Hulstijn, 2011; Rubin & Henderson, 1982; Smits-Engelsman, Niemeijer, & van Galen, 2001). Although most attention is directed to learning and practicing writing in school classrooms, between 30% and 60% of time spent in educational process (Volman, van Schendel, & Jongmans, 2006), over time, difficulties in writing occur with increasing numbers of students. Beside the current educational trends and the possibilities of applying modern assistive technology in working with this group of students, as well as the possibility of adapting the teaching process to students who face these difficulties, there is no decrease in the number of students with difficulties in writing. Therefore, special attention should be paid to the study of this problem and the task of the researcher should be oriented towards finding the factors that influence the writing process. In order to classify strategies that will contribute to reducing the number of students with disabilities, first we need to acquire knowledge about the writing quality of elementary school students, and this is a special contribution of this research.

The quality of writing of elementary school students

By entering first grade, from students are expected to master the writing skills of the appropriate quality. The ability to write quickly and legibly, according to Bosga-Stork et al., (2016) is necessary and important, and is a complex functional task that is essential for expressing ideas and thoughts in textual form.

The speed of writing, as one of the elements of the quality of writing of the elementary school students, is very important for the writing process and is the speed at which the student writes a certain number of letters over a period of time, usually one minute. The results of various studies (Bosga-Stork et al., 2016; Graham et al., 1998; Ziviani & Watson-Will, 1998) show that writing speed, as one of the parameters of writing quality, changes with age. Due to the development of perceptual, motor and gnostic skills, as well as exercise, the speed of writing increases during the elementary school period.

Studies (Bosga-Stork et al., 2016; Tse, Thanapalan & Chan, 2014) show that the writing speed of elementary school students who have writing problems is much lower than the writing speed of students who do not have these problems. When transcribing text, students with writing difficulties, at the age of 10, write with an average writing speed of 29.9 letters per minute, while students without difficulty with writing have an average writing speed of 40.9 letters. The writing speed of these two groups of students also differs in dictation, with the average writing speed of students with difficulty writing is 28.5 letters and students without difficulty 38.8 letters per minute (Tse et al., 2014).

Researching the speed at which students write is very important because it can represent a parameter on the basis of which educational programs are created and adjust the teaching process to students. Curricula are, today, defined and oriented towards the average student, thus neglecting those students who have some difficulties in teaching, but also those students who are particularly prominent in their realization. Consequently, students who have difficulty writing at the speed expected of their age, will encounter difficulties in following the teaching process on a daily basis. Usually these students will not be able to get the time to copy the text from the board or when dictating, they will have difficulty writing the composition because they will always lack the time to complete the required task.

Consequently, inadequate writing speeds may also affect students' academic achievement, and over time, these students become unsuccessful students with lower grades. As research (Center & Wascom, 1986; Kravetz et al., 1999) shows that difficulties in mastering teaching materials reflect the socio-emotional aspect of personality, special attention must be paid to this issue.

METHOD

The subject of this research is the writing speed of students lower grades elementary school, students from grades I to IV, with the aim of determining are there any differences in the speed of writing depending on the manner of accomplishing the tasks and the age of the respondents. The research tasks are defined in relation to the way the tasks are accomplished and are:

- Examine student writing speed to mind;
- Examine student writing speed when transcribing text from short distance;
- Examine student writing speed when transcribing text from a longer distance;
- Examine student writing speed when writing by dictation.

The starting hypothesis is that there are differences in the writing speed of students of different grades, as well as that there are differences in the writing speed depending on how the tasks are accomplished.

Assessment of writing speed was performed by student testing. The McMaster Handwriting Assessment Protocol - 2nd edition (Pollock et al., 2009), which was translated and adapted to the Serbian-speaking language (Denić and Milivojević, 2014) was used as a measuring instrument for writing assessment. The protocol involves evaluating writing across multiple modalities. Writing is assessed as writing to mind, transcribing text from a short distance, transcribing text from a longer distance, and writing by dictation. The texts used in the protocol were taken from the Serbian language classbook for the first, second, third and fourth grades, and therefore adapted to the age of the students. During each activity, was recorded the time the activity was completed. The counting writing speed was based on the formula and then compared to the defined norms and it was determined whether it was adequate, below or above average. The defined rate of writing speed for first grade students is 15-32 letters per minute. The defined writing rate for second grade students is 20-35 letters per minute. The defined rate of writing speed for third grade students is 34-70 letters per minute. The defined rate of writing speed for fourth grade students is 46-91 letters per minute. Based on the assessment of writing speed, students were divided into a group of students with difficulties in writing and a group of students without difficulty in writing.

The survey involved 1156 students lower grades from eight Belgrade elementary schools. Regarding the gender structure of the sample, data were collected for 564 (48.8%) boys and 592 (51.2%) girls. The survey included 278 students (24% of the total sample) of the first grade, 325 students attended the second grade (28.1%), 270 students attended the third grade (23.4%) and 283 students attended the fourth grade (24.5%). Excluded from the study were students who, based on school and medical records, were found to have low intellectual functioning, as well as some of the neurological impairments that manifest themselves in the quality of mobility of the upper extremities.

The survey was completed during the second half of 2016 in Belgrade. The schools included in the survey are those located in the urban municipalities of the city of Belgrade, excluding suburban municipalities and thus the impact of the environment on the results of the research. One school was selected from each municipality, and from each school all classes of the first, second, third and fourth grades.

The analysis and interpretation of the data referred to the results obtained by the assessment of the respondents. Descriptive statistics measures were used in the statistical processing of data, and Pearson's correlation coefficient was used to examine the correlation of variables. The data were analyzed using the SPSS statistical package, 20 for the social and humanities sciences.

RESULTS

Respondents' writing speed on individual tasks as well as average writing speed are shown in Table 1.

Table 1. *Descriptive indicators of writing speed on individual tasks and in total*

Task	**N**	**Min.**	**Max.**	**M**	**SD**
Writing to mind	1156	12.00	97.83	40.86	16.54
Transcribing text from a short distance	1156	7.47	94.04	37.88	16.17
Transcribing text froma longer distance	1156	7.82	91.47	36.31	15.90
Dictation	1156	9.53	95.45	38.23	16.44
Average on four tasks	1156	11.00	94.30	38.31	16.06

As can be seen in Table 1, the average writing speed is the highest in the writing task to mind, slightly lower in the short-distance and dictation tasks, and the lowest when the long-distance text is transcribed. The average writing speed of a student when writing to mind is 40.86 letters per minute. The average typing speed when transcribing text from a short distance is 37.88 letters per minute, while transcribing text from a longer distance is 36.31. The average writing speed for dictation is 38.23 letters per minute. The average writing speed across all four tasks is 38.31 letters per minute.

The effect of task type on writing speed was examined using one-way analysis of variance (ANOVA) with repeated measurements, and in the analysis the tasks were treated as different levels of factors. The results of the statistical analysis applied confirm the significant effect of type of task on writing speed (F (2.778, 3208.02) = 466.34, p = 0.000), with task type explaining 29% of the variance in writing speed. An additional (Bofferroni post hoc) test showed that differences among all arithmetic environments were statistically significant, and that the overall effect of type of task on writing speed could be first attributed to the significant difference in the rate at which subjects write to mind compared to the other three tasks (SD = 2. 62 - 4.54, p = 0.000), significantly higher typing speed from a smaller distance than transcribing text from a longer distance (SD =

-1.57, p = 0.000), significantly faster typing than dictation short distance text (SD = -0.35, p = 0.010) and longer distance transcription (SD = -1.92, p = 0.000).

The following table (Table 2) shows the correlation between writing speed tasks.

Table 2. *Correlations between writing speed tasks*

Task	1	2	3	4
1 – Writing to mind	1			
2 – Transcribing text from a short distance	0.96**	1		
3 – Transcribing text froma longer distance	0.97**	0.96**	1	
4 – Dictation	0.97**	0.97**	0.97**	
5 – Average on four tasks	0.98**	0.99**	0.98**	0.99**

Note. ** level significant correlation 0.001

Correlations among individual tasks indicate that performance on one task can be a significant predictor of performance on other tasks as well as overall score. All correlations between tasks are very high (over 0.90), positive and statistically significant (Table 2), which means that not all four tasks need to be used in the estimation of writing speed, but that in a situation where a more economical evaluation procedure can be applied just one of them. However, deciding whether only one of the assessment methods will be applied in this case depends first on what we evaluate and what the purpose of the results is.

Table 3 shows the average writing speed of individual tasks by grade.

Table 3. *Descriptive indicators of writing speed on individual tasks by grade and results of checking the significance of differences between groups*

Task	Grade	N	M	SD	Min.	Max.	Welch's t (df)	p
Writing to mind	I	278	25.12	6.55	12.00	79.67	**846.85 (3, 611.29)**	**0.000**
	II	325	31.30	6.74	13.71	56.23		
	III	270	47.71	10.32	28.00	97.83		
	IV	283	60.76	11.55	27.50	97.14		
Transcribing text from a short distance	I	278	22.27	5.98	8.40	42.26	**841.31 (3, 613.14)**	**0.000**
	II	325	28.80	6.97	7.47	54.86		
	III	270	44.71	9.66	23.11	78.00		
	IV	283	57.12	11.89	18.38	94.04		
Transcribing text froma longer distance	I	278	20.96	5.72	7.82	40.20	**875.05 (3, 611.02)**	**0.000**
	II	325	27.50	6.69	9.92	53.68		
	III	270	42.52	9.91	20.71	77.65		
	IV	283	55.58	11.26	15.72	91.47		
Dictation	I	278	21.85	5.73	10.60	42.00	**934.78 (3, 610.54)**	**0.000**
	II	325	29.24	6.78	9.53	58.89		
	III	270	45.30	9.99	20.79	77.78		
	IV	283	57.89	11.57	21.00	95.45		
Average on four tasks	I	278	22.55	5.52	11.00	41.42	**926.23 (3, 610.74)**	**0.000**
	II	325	29.21	6.53	12.14	54.28		
	III	270	45.06	9.57	24.42	76.49		
	IV	283	57.84	11.15	22.31	94.30		

An overview of the arithmetic means given in Table 3 clearly indicates that writing speed increases with age (grade), both on individual and total tasks. This conclusion is supported by the results of the statistical verification of the significance of differences between arithmetic means. First grade students, at literacy stage, write slowest when transcribing text from a longer distance (M = 20.96) and when writing by dictation (M = 21.85), second grade students write the fastest to mind (M = 31.30) and while writing in dictation (M = 29.24), while in upper grades students achieve the highest writing speed by letter (M = 47.71 in III grade students, M = 60.76 in IV grade) and dictation (M = 45.30 for grade III students, M = 57.89 for grade IV students).

Because Levin's test for homogeneity of variance showed that sub-sample variance is unequal, instead of results of one-factor analysis of variance, the results of robust tests (t-test for independent samples) and the corresponding Welch's t-statistic (Welch's t) are shown. The Welsh t-test is significant in all comparisons and confirms the existence of a statistically significant class effect on writing speed on all tasks.

Table 4 shows the results of Bonferoni's follow-up test.

Table 4. *Results of Bonferoni's follow-up test*

Dependent variable	**(I) Grade**	**(J) Grade**	**Grade AS (I-J)**	***R***
Writing to mind	I	II	-6.17*	0.000
		III	-22.59*	0.000
		IV	-35.63*	0.000
	II	III	-16.41*	0.000
		IV	-29.46*	0.000
	III	IV	-13.05*	0.000
Transcribing text from a short distance	I	II	-6.53*	0.000
		III	-22.44*	0.000
		IV	-34.86*	0.000
	II	III	-15.91*	0.000
		IV	-28.32*	0.000
	III	IV	-12.41*	0.000
Transcribing text froma longer distance	I	II	-6.53*	0.000
		III	-21.56*	0.000
		IV	-34.62*	0.000
	II	III	-15.02*	0.000
		IV	-28.08*	0.000
	III	IV	-13.06*	0.000
Dictation	I	II	-7.38*	0.000
		III	-23.44*	0.000
		IV	-36.04*	0.000
	II	III	-16.07*	0.000
		IV	-28.66*	0.000
	III	IV	-12.59*	0.000
Average on four tasks	I	II	-6.66*	0.000
		III	-22.51*	0.000
		IV	-35.29*	0.000
	II	III	-15.85*	0.000
		IV	-28.63*	0.000
	III	IV	-12.78*	0.000

Subsequent (post hoc) tests confirm that the increase in writing speed is consistent, and that the order on all tasks can be described as follows: children in grade I write slowest, type II write faster than them, grade III students write more words than children from the first two grades and, finally, respondents attending grade IV achieve significantly higher success on all tasks than children from the first three grades (Table 4).

The analysis at the level of the respondents shows that inadequate writing speed, when looking at the average speed on all four tasks, occurs in 78 (6.7%) students, while in the remaining 1078 (93.3%) the writing speed is in line with the age standards ie. class. The percentage of children writing at an inadequate rate by grade is shown in Table 5.

Table 5. *Frequency of subjects with inadequate writing speed per class*

	Grade			
	I	**II**	**III**	**IV**
N within the class	19	16	18	25
% within the class	6.8	4.9	6.7	8.8

Table 5 makes it clear that students who write slower than expected for age are evenly ranked by grade level. This is also confirmed by the insignificant value of the Hi-square test (χ^2 (3) = 3.68, p = 0.298). The highest percentages of students who have difficulty writing speed attend fourth grade (25 or 8.8%), followed by first grade (19 or 6.8%), while these difficulties are reported in 18 third grade students (6.7%). Difficulties in writing speed are the least common among second grade students (16 or 4.9%).

DISCUSSION

Writing quality of student of elementary school was observed based on an assessment of writing speed. The average writing speed of lower elementary school students is highest in the writing task to mind (40.86 letters per minute), slightly lower in the tasks of short-distance text transcription (37.88 letters per minute) and dictation (38.23 letters per minute) and the smallest when is transcribing text from a longer distance (36.31 letters per minute). The average writing speed across all four tasks is 38.31 letters per minute. There was a significant effect of task type on writing speed (F (2.778, 3208.02) = 466.34, p = 0.000), with a correlation between tasks (r < 0.90).

Writing to mind, in this case, writing the first and last name of the student and the name of the school they attend, is first mastered, and therefore becomes first automated in students (Gerth et al., 2016). Levin et al., (2005) have shown that preschoolers write their name much better than other words, while Fayol and Miret (2005) find that students with poorer graphic skills have worse achievement when writing text dictates.

As expected, the writing speed on these four tasks also varies with the age of the subjects. First grade students, at the literacy stage, write slowest when transcribing text from a longer distance (M = 20.96) and when writing by dictation (M = 21.85), while in upper grades students achieve the highest writing speed when writing to mind (M = 47.71 for grade III students, M = 60.76 for grade IV students) and writing by dictation (M = 45.30 for grade III students, M = 57.89 for grade IV students). As students practice their writing skills, so does increases their writing speed. It is characteristic for first grade students who write at the literacy stage that the slower writing speed is achieved when writing by dictation, due to insufficient spelling of the letters, but also when writing from a greater distance, due to numerous obstructive factors (short-term attention deficit, visual perception, visual motor coordination, motor planning), and because they are in the process of getting used to copying text from a board, or from a greater distance.

As in previous studies (Graham et al., 1998; Stievano et al., 2016; Ziviani & Watson-Will, 1998), the results of this study show that writing speeds increase with age, both on single and total tasks. The first grade children write slowest, the second grade faster than them, the third grade students write more words than the children in the first two grades, and finally, the students attending the fourth grade achieve significantly higher success on all assignments than the children in the first three grades. By examining the speed and legibility of text in elementary school students, ages 7 to 12, Ziviani and Elkins (1984) found that the slowest writing was for students between the ages of seven and eight (girls 38.77 ± 15. 12, and boys 34.90 ± 11.05), and the fastest writing is for students who are more than 12 years old (girls 84.68 ± 18.77 and boys 110.76 ± 28.49).

The speed at which students write is influenced by a number of factors, which is why there are decent differences in writing speed when completing different tasks. So, for example, transcribing text is different from spontaneous writing because students have to look at the transcribed text, memorize it, reproduce it accurately on paper, and take care of the organization of the text in relation to the paper, lines and margins . If their attention is disperse, and there are some factors that hinder their attention at that moment, with difficulty in sensory integration, students may achieve a writing speed lower than the writing speed by writing to mind or by dictation.

Based on the study conducted by Tse et al., (2014) and Longcamp et al., (2006) conclude that visual and kinesthetic feedback are very important parameters of writing, as complex visual-perceptual abilities. Therefore, when dividing students into a group that has difficulty writing, the average writing speed across all four tasks was observed. Inadequate writing speed, if one considers the average speed on all four tasks, occurs in 78 (6.7%) students and their frequency is evenly distributed across classes. Difficulties in writing, observed through inadequate writing speed, occur in 6.8% of first grade students, 4.9% of second grade students, 6.7% of third grade students and 8.8% of fourth grade students. As in previous studies (Santos Damasceno, Brandao de Avila, & Arnaut, 2015), the results show that there are no differences (p= 0.164) in the frequency of writing problems among students of different grades.

CONCLUSION

Based on the results presented and analyzed, the following conclusions can be drawn:

- The average writing speed of a student lower grades elementary school is the highest in the writing task to mind (40.86 letters per minute) and the lowest when text is transcribed from a longer distance (36.31 letters per minute). Consequently, there is a difference in the average writing speed of the students of elementary school with the class of the students, with a significant effect of the type of the task on the writing speed (F (2.778, 3208.02) = 466.34, p = 0.000);

- A review of arithmetic means clearly indicates that the speed of writing increases with age, that is, with class, both on tasks individually and on the overall score;
- Inadequate writing speed, when looking at the average speed on all four tasks, occurs in 78 (6.7%) students, while in the remaining 1078 (93.3%) the writing speed is in line with the norms for age or class.

All four tasks need not be used in the estimation of writing speed (writing to mind, transcribing text from a short distance, transcribing text from a longer distance, writing by dictation), but in a situation where a more economical estimation procedure may be required, only one of them can be applied. Assessment through all four tasks is only meaningful when adapting teaching materials to students who have difficulty writing. However, the decision whether to apply only one of these four methods of assessment and which depends first of all on the needs of the assessment itself, that is, on the very purpose of the results obtained.

Looking at the school system today, it can be concluded that school plans are too large for most students because the teaching process is planned according to the average student. Research (Coker et al., 2016; Cutler & Graham, 2008) shows that teachers mostly apply front-line work in the literacy process, then apply small group work in about 23% and devote to individual instruction in about 24%. Cutler and Graham (2008) also concluded that teachers focus more on instruction than on the writing process itself. When a student who have difficulty mastering school skills, such as writing skills, is found in these conditions, the problem arises because of the no unconformity of the program to the student. In recent years, the school system has been making changes to its curricula and thus adapting the educational process to students with special educational needs, allowing full participation of students in teaching. As a result, a more adequate acquisition and expansion of students' knowledge, skills and habits results.

The results obtained are very important for the process of adapting the teaching process to students with difficulties in writing, as well as finding a way of writing that most convenient the student, his needs and abilities. Individualization measures and an individual education plan are ways of adapting the educational process to students with disabilities, thus fully enabling students to participate in teaching activities, respecting the individuality of the student, while respecting his or her strengths and capabilities.

Writing problems are very often the first indication that there is a developmental delay in perceptual, motor and speech capacities (Bosga-Stork et al., 2016; Piller & Torrez, 2019). Therefore, many students who have problems with writing need the help and support of a special educator, or specialist who deals with writing problems (Bonney, 1992), because knowledge of the factors that affect writing skills is necessary to create an adequate plan to stimulate writing (Deninis & Swinth, 2001), and the stimulation of these abilities is significantly related to the writing skill (Mehta & Nandgaonkar, 2019).

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APPROACHES AND METHODS IN THE QUALITY OF PRISON LIFE ASSESSING – MEASURING SOCIAL AND MORAL CLIMATE IN PRISONS

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SUMMARY

One of the most important topics in contemporary criminology refers to the functioning of penitentiary systems. Special emphasis is on the role of environment and the impact that environmental factors have on the behaviour of convicts and successfulness of their social reintegration, as the imprisonment purpose. Within this framework, one possible approach involves exploring the concepts of both the quality of prison life and social and moral climate in prisons with the introduction of standard methods for assessing or measuring them. Concept of the quality of prison life, as a multidimensional construct, and the effect of social and moral climate on the overall and future behaviour of prisoners are discussed in this study. Definitions and operationalizations are presented, followed by the presentation of Measuring the Quality of Prison Life survey as a valid tool for understanding the contemporary experience of imprisonment. The systematization of knowledge on the about the interdependence of these concepts was conducted through a review of available literature. This study might encourage the initiation of further exploration of the dynamics of prison life in Serbia. That way, by promoting an expanded and systematical research focus on the quality of prison life, it would be possible to improve both prisoner treatment and superintendence.

Key words: quality of prison life, prison social climate, crime, prison conditions, rehabilitation, social reintegration, resocialization

INTRODUCTION

Believing in the potential for socialization, many scholars in recent decades have turned their attention to discovering the conditions and factors that contribute to the achievement of success in the execution of prison sentences. Analysing and explaining the consequences and impact that imprisonment has on the future behaviour of a former convict should be an important task not only for prison professionals (those implementing treatment programs) but also for the general public, penologists, criminologists, sociologists and policymakers. This multidisciplinary approach is necessary in order to eliminate all negative factors arising out of the prison environment and to summarize the knowledge necessary for successful social reintegration.

Extensive research has been published aimed at examining the effects of the moral and social climate in prison on the imprisonment, in the broadest sense. Major advances in the study of the effects of imprisonment, among other, include a growing understanding that desistance from crime is a process that involves changes in behaviour and identity, besides an effort to re-establish a place among other members of the moral and social community (Auty & Liebling, 2020; Ilijić, 2019; Pavićević, Bulatović, & Ilijić, 2019).

Focusing on the negative consequences resulting from prison deprivation and their prevention, while at the same time endorsing the positive interpersonal relationships, could prevent adverse outcomes and violence in prison communities. However, social forms and habits condition prison life. It is crucial for prisoners how staff treat them, with particular emphasis on respect, humanity and fairness (Liebling, Hulley, & Crewe, 2011). Extreme disrespect, along with dishonest or humiliating treatment, causes psychological suffering, anger, anxiety and depression (Liebling, 2011b).

One of the first questions that arise is whether convicts would respond more favourably to treatment if they felt that the quality of life in prison was good enough. These settings raise several other key questions regarding what is perceived as the quality of life in prison, what determines whether the quality of life is perceived as higher or lower, and which entities or agents are relevant to it. The perception of the quality of life in prison and the preservation of the mental health of prisoners are highly important, with far-reaching consequences on the future behaviour of former convicts, including the successfulness of social reintegration. Here, environment and environmental factors have profound impact. Lastly, there is a question of the impact that quality of life in prison can have on rehabilitation (Park, 2018).

Back in 1995, Lösel has pointed to the "major deficits" in studies that had evaluated correctional treatment and its effects. In summary, this attitude was substantiated by the lack of an adequately grounded theory and purposeful measurement of characteristics associated with the prison social climate at the time (Lösel, 1995). As Auty & Liebling (2020) have noted, the initial premise was that treatment was the only variable important for the success of treatment, thereby limiting the research fields of study previously conducted. Accordingly, it turned out that some wider aspects of the social and moral climate in prisons needed to be taken into consideration, as well as their impact on the outcomes of the treatments used.

Despite the increasing interest of criminologists in the subject of the concept of quality of life in prison over the last decade, there is still a lack of theoretical and empirical research on prison conditions and quality of life in prison (Park, 2018). One of the more recent but rare surveys conducted in the region has been published in 2017. The research was aimed at the relationships between the moral quality of prison life, the mental health of prisoners and the risk of exposure to violence in the main prison for adults in Dubrava Correctional Centre in Kosovo (Skar et al., 2019). It turned out that higher levels of respect, fairness, humanity and good relations between staff and prisoners were related to lower levels of violence. Based on all this, it was indicated that improvement of quality of prison life and mental health of prisoners could make a prison atmosphere tolerable and safer.

However, in order to understand the need for exploring the quality of prison life and the concept of quality of prison life, the prison's both social and moral climate need to be explained, mostly through the behaviour of prisoners and prison staff. In Serbia, the research on the characteristics of the social and moral climate in prisons and the quality of prison life is scarce. Therefore, this study focused on the concept of the quality of prison life, as a multidimensional construct, and the effect of social and moral climate on the overall and future behaviour of prisoners. The systematization of knowledge on the about the interdependence of these concepts was conducted through a review of available literature.

Prison social and moral climate

As a term, the social climate is difficult to define and operationalise (Day, Casey, Vess, & Huisy, 2011). Despite the great appeal of ideas about the therapeutic institutional setting, organization's culture or social climate, it has proved difficult to define and operationalize what is meant by these terms in a criminological context (Beech & Hamilton-Giachritsis, 2005; Day et al., 2011; Waters & Megathlin, 2002). Thus, the distinction between the terms "culture" and "climate" needs to be made more precisely. These two terms are often used interchangeably, although there are some complex distinctions in their implied meaning. As Melnick, Ulaszek, Lin, & Wexler (2009) have summarized, organizational culture is most usually recognised as the overall, key values and activities and condition of an organization or set of shared beliefs among members of an organization. Organizational culture has a central role in determining the attitudes, perceptions, goals of the organization, and behaviour of members of the organization. On the contrary, Day, Casey, Vess, and Huisy (2011) have reminded us that climate usually relates to an organization's perceptions at the operational level, and that is its capacity to be supportive to new ideas and its receptiveness and responsiveness to change.

The literature review reveals a large number of different terminological definitions and determinations of the term "social climate", generally agreeing that it is a multidimensional construct. Auty and Liebling (2020) have reintroduced the definition set by Moos in 1989, which stated that "the material, social, and emotional conditions of a given unit and the interaction between such factors". Furthermore, they have reminded us that in 1990 Ajdukovic has described the climate through the way that members of an organization perceived "a set of properties or conditions" that was related to the internal environment of that organization (Auty & Liebling, 2020).

The initial assumption is that a supportive atmosphere in prison wards is the first prerequisite for successful rehabilitation (Schalast, Redies, Collins, Stacey, & Howells, 2008). Moreover, the prison social climate is confirmed as a potential moderator of treatment effects (Schalast et al., 2008). In high-security settings, as prisons are, key features of the social climate relate to whether the climate is seen as a support to therapy and therapeutic change and whether there is the mutual support characteristic for therapeutic communities. Also, the level of tension and perceived threats of aggression and existing violence is among those characteristics, too (Schalast et al., 2008). Provision of the opportunities for learning new skills and prosocial behaviour is constitutional to the social climate, likewise (Tonkin, 2016). Hence, it is of great importance to find a way to assess the extent to which the climate is perceived as supportive of therapy, as well as to therapeutic change. According to the definition set by Wright (1993, as cited in Day et al., 2011, p. 9), the social climate is distinctive for each organization individually, it lasts for a longer time and effects the behaviour of members in the organisation, both staff members and prisoners. At the same time, the social climate is conditioned by workplace development and can be subjected to change. It is not surprising that the concept of social climate, except in the contemporary context of prison life, can be found in both management, work and organizational psychology and medical literature (Day et al., 2011).

In addition, some authors emphasize the need to enhance the definitions by introducing the moral aspect of the prison's environment (Auty & Liebling, 2020). One of the definitions outlines the moral dimension of the prison's environment as "a prisoner's mainly interpersonal and material treatment that render a term of imprisonment more or less dehumanizing and/or painful" (Liebling & Arnold, 2004, p. 473, as cited in Auty & Liebling, 2020). The aforementioned refers to the qualities such as decency, honesty, humanity, relationship with staff and use of authority (Liebling, 2011b). The absence of negative manifestations of these qualities are seen as psychologically painful and can lead to depression, suicide and/or anger, frustration and violence (Auty & Liebling, 2020; Liebling, 2011b). As reported by Johnsen, Granheim, and Helgesen (2011), Liebling (2004a, 2007) has noticed that the prison's moral climate is under the influence of the mental attitude of staff and consequently, their attitude towards prisoners.

Within an institutional environment, social climate may also have the potential effects on other aspects of prison life, in addition to the mentioned influence on rehabilitation. Among some of the factors listed as correlates of social climate are the following: quality of training, environmental stress level, the sufficiency of staffing, adequacy of supervision, lines of authority in terms of organization and coordination, current policy and up-to-date regulations. What needs to be emphasized, the general quality of life was cited as key features, too (Day et al., 2011).

Summarizing the findings of previous studies, among others things, it was concluded that perceptions of social climate were associated with the readiness to use of force by prison officers and correctional staff, but also with the incidence of prison riots, disturbances, and general disorder (Day et al., 2011). Three dimensions of climate influenced expressed readiness to use force, namely, authority, fear of victimisation and quality of supervision were found to be significant predictors on the readiness to use force against inmates (Griffin, 1999). On the other hand, there is an empirical basis to support the connection of social climate and staff productivity, job performance, and work stress (Day et al., 2011).

The concept of quality of prison life and its assessment

Over the last three decades, interest in research quality of life continues, whereas the intensification of interest in this concept is also noticeable within the national scientific and professional public (Milićević, 2017). The concept of quality of life in prisons is commonly associated with rehabilitation in terms of a causal relationship. This starting point is explained by assuming that prisoners may respond better to treatment in correctional institutions if their satisfaction is at a higher level. Numerous authors have analysed the importance of the quality of prison life through its relation to re-socialization and reduction of recidivism or risk of crime, listed as the ultimate goal of rehabilitation. Moreover, they have also tried to determine the influence of factors that may be related. The empirical research evidence of the relationship between the quality of prison life and the response to a certain type of rehabilitation treatment has yielded unexpected results (Park, 2018). A distinction should be made with regard to the quality of life of an individual, which is a complex and multidimensional construct most commonly defined as an individual experience of satisfaction with all aspects of life, that is, a perception of one's own well-being and satisfaction with life. Quality of life includes physical, social, economic and psychological well-being, a sense of positive social inclusion and the ability to realize one's potential, and includes the psychosocial domain (emotional, social) and the physical or health-related domain (Milićević, 2015). On the other hand, the everyday life of prison staff and prisoners is conditioned by a wider social context about what constitutes the purpose of prison. A transition from rehabilitative or corrective to a pragmatic and managerial approach (Pavićević, Ilijić, & Stepanović, 2020), whereas the conceptualization of goals and organization of prison life occurred in the 1980s and is evident in the follow-up work of several authors in the US and the UK (King & McDermott, 1995; Logan, 1992; Saylor, 1984; all as cited in Liebling et al., 2011). This transition has included an increased emphasis on less aspirational "custodial" goals such as security and order. In addition, shifting focus from social and individual change has worked in favour to developing relatively precise concepts suitable for operational use and empirical measurement, thereby losing the experience of prisoners (Liebling et al., 2011, p. 359).

Many limitations of measurement and evaluation techniques have been identified based on conceptual limitations. Consequently, the measurement of quality of life in prisons could not have been substantially improved. An attempt to conceptualize the answer to the question of how prison experience should be presented in empirical research has highlighted the importance of perception and experience. At the same time, an effort was made to avoid a narrow managerial and correctional framework. This is what makes a range of humanistic values crucial to the experience of prison life (Liebling, assisted by Arnold, 2004 as cited in Liebling et al., 2011).

One of the first criminologists to focus research on the quality of life in prisons is Alison Liebling (Park, 2018). As a researcher, she attempted primarily to provide empirical support of the impact that the behaviour of prison staff had on prisoners' quality of life. A series of empirical and theoretical research focused on the quality of life in prison attempts to do just this: to provide a conceptual and methodological foundation for understanding prison life, including nature, quality, management and effects of prisons (Liebling, 2012, p. 3).

The complexity of this multidimensional construct has resulted in the emergence of numerous instruments designed to evaluate it (Milićević, 2017). The "MQPL" (Measuring the Quality of Prison Life) survey is designed in an attempt to provide valid tools for understanding the contemporary experience of imprisonment. This questionnaire was created as a refined result of several research projects aimed at improving the overall understanding of prison life and experience and their influences (Liebling et al., 2011). More importantly, the "MQPL" was designed analytically and empirically through comprehensive explorations on what matters in prison, in which both staff and prisoners were included (Liebling, 2012; Liebling et al., 2011). Given its "research-for-knowledge" nature, appropriate measurement of a prison's quality, in addition to the accurate and authentic description, explanation, and conceptual clarity, are listed as primary goals of several research projects successively research conducted from 2001 to 2011 (Liebling, 2012). The analytical approach applied in the original study of quality of life in prison is turned to begin prisoner and staff experiences in prison by examining it based on organized observation and in-depth interviews conducted in five prisons over one year. This new type of research addresses the identification and relationships of complex and important aspects of prisoners' lives by identifying the values that complex aspects of prison experience have for them. The prison experience is seen as a multidimensional and primarily relational category. Methodological and conceptual difficulties in researching the quality of life in prison communities are present and not small because what is measurable is often not the most important for prisoners. The primary task of the research was to identify what was important to prisoners and why, and this was achieved in two ways.

The first part of the research was based on appreciative inquiry (AI). Concisely, this AI method can be described as the search for something that triggers life, brings well-being, and something that is perceived as painful in order to move the research beyond "existing reified patterns of discourse" (Ludema et al., 2001; Elliott, 1999; Liebling, assisted by Arnold, 2004; all as cited in Liebling et al., 2011). At the time, it was an innovative way of looking at the work of prison officers. It was developed on the basis of the concept of sensitivity and lived experience, narratives and meaning (Liebling, Price, & Elliott, 1999)[a]. More precisely, it is an inductive process that begins with exercises aimed at imaginative conversation and continues with a loosely structured interview. The method is creative and mostly qualitative. Discussing on the method of AI and relationships in prison, Liebling, Price, and Elliot (1999) concluded that it has a distinct power and relevance in the prison setting. They have drawn several conclusions about staff-prisoner relationships and the AI method.

A staff-prisoner relationship was listed first, as it is influential in multiple ways in prison. Empirically speaking, a staff-prisoner relationship was emphasized since it is very complex. The latter is particularly noticeable in the duality between the formal and the informal aspect of officers' work, with differences grouped into three domains (relationships, rules and procedures, privileges). Lastly, prison officers are in charge of social control, which includes conflict-avoiding, tensions resolving and the use of discretion, and they are responsible for decision-making related to order and peace (Liebling et al., 1999).

Regarding the AI method as a research method conducted in a maximum-security prison, Liebling et al., (1999) noticed a restricted range of used language. This led them to conclude that prison setting restrains language and imagination, possibly through authority or control, through everyday routines and developed insensitivity and indifference. Consequently, it is not surprising that it appeared that language was unevenly restricted, reflecting the institutionalized negativity and weak responsivity to success. Finally, there was a conclusion about approaches to prisons research, given that the AI method is action research.

The workgroup exercises were conducted in close cooperation with groups of staff and prisoners. The identification of topics was achieved through this process. On this basis, several dimensions were identified, which were highlighted by the

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[a] symbolic interactionism

study groups as important. The first round created a list of important but difficult to measure conceptual dimensions, such as "respect", "humanity", "security", "trust", with a high degree of consensus in identifying the relevant dimensions. This allowed the transition to the second phase of quantitative "measurement". Key dimensions identified are respect, humanity, staff- prisoner relationships, support, trust, fairness, order, safety, well-being, personal development, family contact, power, meaning, and decency. Respect and humanity were almost always appeared as the most highlighted dimension (Liebling et al., 2011, p. 360).

The second part of the research was deductive. It was based on a detailed quality of life survey founded and supplemented by the AI method and structured around the dimensions previously identified (Liebling et al., 2011). Dimensions of the quality of prison life were a sociologically imaginative and empirically rich, but well-defined, method for quantitative measurement based on qualitative analysis. It should be noted that these dimensions were both empirical and theoretical constructs, with quantification retaining meaning, depth, and individual contact in qualitative interviews. The aim was to develop the principles of general applicability under prison conditions. This outcome was referred as a measure of the "moral performance" of prisons (Liebling, assisted by Arnold, 2004, as cited in Liebling et al., 2011, p. 362).

The revision of the "MQPL" survey has brought some changes. First, prison privatisation was taken into account and private sector prisons were included. Such improvement is logical and unsurprising. In the 1980s and 1990s, the private sector has documented greater success compared to the public sector when it comes to providing humane and reasonable treatment (Liebling, assisted by Arnold, 2004, as cited in Liebling et al., 2011, p. 362). Hence, this was a seven-prison survey-based study that included two public and five private sector prisons.

The "MQPL" survey working dimensions during the study included the following: entry support, distress on entry into custody, assistance for the vulnerable, individual care, dignity and material needs, relationships, respect, fairness, order and security, physical safety, care and safety, policing and sub-culture, meeting needs, personal development, family contact, personal autonomy, wellbeing, frustration, compliance/resistance, and relationships with peers (Liebling et al., 2011, p. 365).

A total sample included 1147 prisoners. Initial principal components analysis was conducted on 148 items, resulting in the occurrence of 32 factors. Repeated principal components analysis was conducted only on those initial factors that had eight items or more loaded. Finally, a combination of conceptual and statistical methods was performed through a process of theoretical reflection on the factors generated through field experience and interviews and finally validated through statistical verification. The final dimension set is thematically grouped into five overarching categories. Those were the following categories: *harmony dimensions*; *professionalism dimensions*; *security dimensions*; *conditions and family contact dimensions*; and *wellbeing and development dimensions*. The aforementioned and other dimensions examined in this research represent a carefully balanced conceptual framework for re-thinking the moral quality of prison based on the prisoner's experience. This survey is a tool for reflection and analysis, as well as for "identification of symptoms" that are indicators of moral failures and the pursuit of legitimacy (Liebling et al., 2011).

The *harmony dimensions* represent mainly interpersonal and relational aspects of the prison experience. This category consists of *entry into custody*, *respect/courtesy*, *staff–prisoner relationships*, *humanity*, *decency*, *care for the vulnerable*, as well as *help and assistance*.

The largest differences between prisons were found in *professionalism dimensions*. The professionalism dimensions refer to essential features of the prison work as a job, which include communication skills, competence, knowledge, experience, and expertise, internalised and organisational values. Professionalism dimensions are composed of *staff professionalism*, *bureaucratic legitimacy*, *fairness*, and *organisation and consistency*.

The *security dimensions* incorporate *prisoner safety*, *prisoner adaptation*, and *drugs and exploitation*. In other words, those are the rule of law, proper use of authority, behaviour regulation, and the provision of safety. Next, *regime decency* and *family contact* are the aspects of the *conditions and family contact dimensions*.

The *wellbeing and development dimensions* are associated with *personal development*, *personal autonomy*, *wellbeing*, and *distress*. Overall, it is related to how prisoners perceive their wellbeing, what is their capacity to act autonomously, what is the level of support for their personal development, etc.

What is the relationship between prison social and moral climate, prisoner experience and behaviour and the quality of prison life?

Prisons differ in the manner the staff treats prisoners, in addition to the feeling of safety, trust and power that prevails through the institution (Liebling, 2011b). The idea to explore prison quality arose from the attempt to operationalize “differences that matter”, previously determined by a qualitative research approach that included both staff and prisoners. There are several basic dimensions recognised as fundamental when it comes to interpersonal treatment, and these are the following: respect, humanity, fairness, order, safety and staff–prisoner relationship (Liebling, 2011b, p. 534). It is noteworthy that when the prisoners’ perception of the quality of prison life was further analysed, the prisoner–staff relationship was verified as more important than other (more material) aspects of prison quality (Johnsen et al., 2011).

Evaluation of the policy of incentives and earned privilege in prisons in England and Wales is another example (Liebling, 2008). This study pointed to the prison staff discretion, relationships with prisoners, and fairness as the factors influencing the prison life, among others. It was also indicated that, at the time, such a prison policy had a mainly negative effect on the behaviour of prisoners and their perceptions of fairness and relationships with prison staff (Liebling, 2008). The results showed that the prisoners who felt they were treated unfairly became indignant, as a direct negative impact on their perception of the quality of life. While suggesting that certain types of prison policies may have an impact on the quality of life and, therefore, prison stability, there was an emphasis on the psychological well-being of prisoners as an important part of rehabilitation, and that it was partly in the hands of prison staff.

A study revealed that prison staff behaviours are influential for prisoners’ perceived quality of life, even more than material or prison factors. Such behaviours need to be balanced to some extent to enable positive outcomes (for instance, improved social skills). In this regard, overpopulation in prisons, cynical views among officer and/or overly permissive staff determine a more unsatisfactory outcome for prisoners, suggesting that further examination must be very cautious when considering the relationships between these factors (Liebling, 2011a). Similarly, Johnsen, Granheim, and Helgesen (2011) called attention to the role that prison workers' attitudes have in the shaping of prisoners' views on the quality of prison life.

A number of studies have also considered the size of the prison, especially since the late 1970s when the need to increase prison capacity has become indicative (Johnsen et al., 2011). Liebling (2008, as cited in Johnsen et al., 2011) has explained that results of research on morale, leadership, safety and quality of prison life question the legitimacy of building large prisons based on presumable cost-effectiveness and efficiency. Quality of life in prison was mostly positive, as rated by prisoners in small prisons. On the other hand, prisoners in medium-sized and large prisons had a mostly negative perception of prison life (Johnsen et al., 2011). Furthermore, prisoners in small prisons had a mostly positive perception of relationships with staff, general treatment and well-being. These three dimensions accounted for more than half of the variance in prisoners' views on the quality of prison life (Johnsen et al., 2011).

When the moral, relational and organizational quality of prison life for prisoner were measured and compared with the proven reoffending, it turned out that higher moral quality of life was related to better outcomes for prisoners on release (Auty & Liebling, 2020).

In research on distinctions and distinctiveness in the work of prison officers, Liebling (2011a) demonstrates that "the moral quality of prison life is enacted and embodied by the attitudes and conduct of prison officers", using different terms to describe the moral and social climate of prison. Certain dynamics shape the prisoners' experience of prison, which includes frustration, pain, well-being or the sense of purpose. That experience can be explained by the work of prison officers.

As suggested elsewhere, prisoners report considerable variations in the moral and emotional climate of similar types of prison (Liebling, 2011b). These differences were related to interpersonal relationships and the treatment and use of authority, leading to extensive differences in perceptions of fairness, security, and different outcomes for prisoners, including suicide rates. Concerning the suicide of prisoners,[b] better treatment leads to the greater well-being of convicts, lower rates of disciplinary offences and lower rates of suicide. Interconnection between high levels of distress and suicide rates in this kind of institutions can be interpreted through significant variations in levels of respect, fairness and humanity of prison staff (Liebling, 2011b, p. 532–533). Prisoners clearly articulate that important differences are those related to interpersonal relationships and treatment, dignity, humanity, and legitimate use of authority and power. All this

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[b] Survey results indicate that prison deprivation is an inevitable product of imprisonment, but also that the intensity of experiencing deprivation depends on the general prison conditions and the regime of execution as personal characteristics of the convicts (demographic, sociopsychological, penological and criminological) (Ilijić, 2014). Imprisonment regime reinforces the sense of deprivation, which, with prior victimization, has been labelled a factor that increases the risk of suicide in female prisoners (Ilijić & Pavićević, 2019, p. 152)

might further leads to great differences in perceptions of the dimension of justice and security, but also of different treatment outcomes (Liebling, 2011b).

Discussing the quality of life of prisoners in Norwegian prisons, given the size of the prison, (Johnsen et al., 2011) concluded that the relationship between officers and prisoners was more positive in small than in medium and large prisons. Furthermore, officers had a more positive view of their relationships with prisoners, except in some of the small prisons where the prisoners' ratings of their relationships with officers were highest.

The prison social climate is also reflected in the degree of (dis)respect for order and discipline (Day et al., 2011). When types of individual aggressive incidents in a male prison population were tested, situational factors were confirmed as predictors of incidents of violence, whether the occurrence of an infraction involved aggressive behaviours directed at staff, another inmate, self, or property (Steinke, 1991). However, it was emphasized that background or personality factors only with situational factors could provide a complete insight into the issue of violence in prisons. When it comes to the level of institutional violence, among the important regime factors are communication between staff and prisoners, staff training, staff experience and staff morale (Cooke, 1992).

There are several basic dimensions recognised as fundamental when it comes to interpersonal treatment, and these are the following: respect, humanity, fairness, order, safety and staff–prisoner relationship. Different types of deprivations of liberty exist, as well as different experiences of the loss of liberty. The subjective sense of the prisoner's loss of liberty can vary considerably not only in relation to institution and jurisdiction but in relation to culture and historical period, too (Liebling, 2011b, p. 546).

Society's orientation towards combating and preventing crime and reducing the rate of recidivism, whether by prevention or rehabilitation, is largely achieved through prison culture and order (Mastrobuoni et al., 2014). Yet, it seems contradictory, but traditional prison conditions appear to be criminogenic. Empirical data suggest a correlation between the reduction of recidivism rates and imprisonment in a mainstream prison, on the one hand, versus imprisonment in an environment radically different from those of other prisons, on the other hand (Mastrobuoni et al., 2014).

CONCLUSION

The functioning of penitentiary systems is one of the most important topics in the criminology, as a scientific research field. Imprisonment has far-reaching consequences on the behaviour of convicts. Further investigations of the impact and the role of environment and environmental factors on the successfulness of their social reintegration could provide additional answers. Concerns about the nature, effects and purpose of imprisonment are justified. In pursuance of the goals of imprisonment, finding the most effective approach to an individual convict is indicated. Within that, both quality of life in prison and social and moral climate should have a central place, not only in future research but also in practical implementation.

This study might support the initiation of further exploration of the dynamics of prison life in Serbia. That way, by promoting an expanded and systematical focus on the quality of prison life, it would be possible to improve both prisoner treatment and management.

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Theme 2

Approaches and Models for Persons with Disabilities in Sports and Physical Education

SPECIAL OLYMPICS UNIFIED SPORTS AS THE POSSIBLE MODEL IN SPECIAL EDUCATION (EXAMPLE OF ATHLETES – PARTNERS COOPERATION IN UNIFIED FOOTBALL)

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SUMMARY

The article presents the Special Olympics (SO) Unified Sports model as a complex means for: a) skills improvement of athletes with intellectual disability (ID), b) cooperation between athletes and partners, inclusion in community, c) influence on public awareness. Unified sports development, principles, benefits are described in detail. Attention is paid to system UNIFY and methods of assessment. The SO theory of "meaningful involvement" proclaims advantage of balanced cooperation between athletes with ID and partners without disabilities in the team during the match. Assessment of the cooperation was provided through observation based on Critical Incident Technique with frequency-counting selected items (pass to athlete with a disability, pass to partner, assistance, shoot, goal, yellow-red card). Two selected unified football teams of boys 7-side SO Unified football were assessed: winning unified team (WUT), winner of all matches, loosing unified team (LUT), looser of all matches. Special Olympics official Individual Football Skill Tests (IST) which included dribbling, passing, shooting, were used for relevance between skills level and attraction in match cooperation (index IST). Results of IST were not in direct relation with cooperation items. Athletes with disabilities preferred asking partners for cooperation. The cooperation is influenced by winning-loosing match development. Despite of the numeric data and absence of assessment of emotional and social items at each tournament the positive team context, satisfied atmosphere was visible. The pleasant mood in the team cooperation seemed to be important marker of benefit of unified sports model.

Key words: intellectual disability, SO Individual Skills Test, Critical Incident Technique assessment, index of activity

INTRODUCTION

Special Olympics Unified Sports System and Policy

Special Olympics Sports Program is considered as the valuable approach to the quality of life of individuals with intellectual disability from the aspect of health and socialization (www.specialolympics.org/research). The Unified Sports System is the unique model which is not included in any handicapped sports federations (Paralympics, Deaflympics etc.). The idea and concept started as a reaction of Special Olympics US on social integration movement in that period (Special Olympics International [SOI], 2003, p.16). In spite of the positive impact of SO on persons with intellectual disability (Block, 1992; Castagno, 2001; Corbin, 2005; Dykens & Cohen, 1996; Dykens, Valkova, & Mactavish, 1999; Rosegard, Pegg, & Compton, 2001; Siperstein & Hardman, 2001), critics remained during the period of discussion and improvement of Unified Sports program even up to late 90ies (Goodwin, Fitzpatrick, Thurmeier, & Hall, 2006, p.164). This discussion and improvement was oriented on the categorical approach, segregation of persons with intellectual disability, less opportunities for communal activities, lack of opportunities for participation of persons with mild level of disability in competition, labelling SO as "only a fun" for persons with severe disability (Hourcade, 1989; Orelove, Wehman, & Wood, 1982; Porretta, Gillespie, & Jansma, 1996; Wilhite & Kleiber, 1992; Wolfensberger, 1995). On the other aspect this discussion supported research results that have improved the Unified Sports process.

Unified Sports Program is based on proportion of number of athletes (with intellectual disability) and partners (without intellectual disability) for year-round training and competition. The basic root of definition includes the main Special Olympics philosophy and goals. The goals of Unified Sports are to improve sports skills and competition behaviour, social contacts with peers, families, and public, and to create opportunity for personal development and society involvement of all participants (Special Olympics International [SOI], 2004). Special Olympics Unified Sports handbook (Special Olympics International, Inc., July, 1989) proclaims the SO unified system is *based on results of pilot projects and accompanying research and evaluation which were conduct during the period from September 1987 through April 1989* (p. 34).

The idea and concept of an integrated softball program appeared in 1983. The next year (1984) Massachussetts Integrated softball program was developed (Special Olympics Unified Sports, Special Olympics, Inc., 2003). A worldwide implementation in team sports was realized by SOI in 1989 and a new name was adopted – *Unified Sports/ events* instead of *integrative* sports. The official unified sports competitions were included in Special Olympic World Summer Games (Minneapolis) in 1991. Participants were recruited from the USA teams: softball, football, volleyball, and bowling. Unified Sports were introduced to Europe in 1991 (France and Eurasia – model of Unified basketball). The research related to SO unified sports was oriented to basketball, bowling, soccer (football), softball, volleyball in the 1980's-1990's.

Due to the systematic development of Special Olympics knowledge about unified sports the explanation of this system was included into basic textbooks (Eichstaedt & Lavay, 1992) and later to Sherrill (1998). The extended study of the benefits of SO unified sports was realized by Siperstein and Hardman (2001) as the reaction to the nearly 30 years development of Unified sports. The purpose of this study was to provide information as to how effectively Unified Sports are implemented, impact and benefit of Unified Sports on US families, coaches, peers, partners, and athletes' life. Questioning of opinion of stakeholders was used, but there was no "field" observation or scaling or measurement. Results concluded Unified Sports had a positive impact on all participants (quality of life, self-confidence, sports skills, social skills and social atmosphere). Recommendations are composed into seven thesis, one of the most important stressed solving the problem of "partner dominance". Despite the broad evaluation and sharing idea of Special Olympics (and Unified Sports) across the USA the number of participants seems to be limited (134 athletes, 145 coaches, 89 family members, 60 coaches).

Social aspects and maladaptive behaviour were examined by Rosegard, Pegg and Compton (2001), especially the effects of participating in a Unified Bowling program on maladaptive behaviours among Special Olympic athletes. Sportsmen aged 11 to 68 years (with a mean of 32 years) participated in 12-week Unified Bowling program. The variables of maladaptive behaviour were checked with the Child Behaviour Checklist (CBCL). Athletes as well as parents were questioned, too. The results seemed to be positive but during the time effect was decreasing.

The first official unified sports competition with wide international participation was realized in 1995 at SO World Summer Games and went through specific development. Unified sports system was adopted for all sports in 1996. Summer sports rules valid for period 1996–1999 and Winter sports rules for period 1999–2001 presented an unified system for swimming, gymnastics, cross-country, etc. "Unified" cross country event 1 km or 10 km were official events on the program of the Winter SO World Games in Toronto 1997. The principle was based on a separate run of athlete and partner, the result was the counted summary of both achieved time-score. This principle was criticized by coaches (personal experience) as lacking in integration or cooperation. Next recommended revision defined Unified Sports for team, dyadic sports (tennis, table tennis, bocce, figure-scating, etc.)

Development of step by step inclusive policy through unified sports can be observed since 80's of the last century. A systematic orientation to the model of unified sports can be considered since 2008. The long-term SOI strategy formulated the main objectives of the unified model in 3 key domains: a) athletes' skills improvement with support of partners; b) inclusion in society through physical activities and sports; c) improvement of positive public awareness toward persons with intellectual disability. The inclusion approach has been implanted in both sport programmes and in health-oriented complimentary programmes. In this sense, numerous programs were established (Healthy Fitness, Expanding Health) of which the most intensive and pompous was the Healthy Community Programme supported by the Golisano Foundation (Válková, 2015; Válková & Krejčí, 2016).

In addition to the development of sports activities, education for the population with intellectual disabilities was emphasized together with the active population. SOI has formulated program UNIFY oriented on medialization and education models based on the unified sports roofed by basic slogan: *New Opportunities arising from Unified Schools and Youth Engagement* leading to Unified Generation (SOI, 2016). Some of sub-models were called: Inclusive Youth Leadership (involvement of experience athletes in training and competitions as leaders), Unified athlete and unified partner (accent on education), Unified volunteer (recruitment and education), Unified School and Unified Champions School (inclusive school policy according unified sports recommendation and competitive criteria), Unified Clubs (inclusive sports clubs policy – accent on inclusive or parallel competition). The SOI reported the estimated number of registered participants in UNIFY (Unified Sports Programs) in 2016 was 1, 400.000. New sports were recommended such as: beach volleyball, basketball 3x3, tandem cycling, dance). These presented models are largely developed in the US environment mainly and are transformed into rules and recommendations for inclusive policy in all registered national SO programmes. Some models are also financially supported by SOI (Golisano Foundation, Samuel Family Foundation, Lions Clubs International, etc.).

Central European countries SO Unified Sports development

Countries from Central Europe have joined the SOI after political and economy changes in beginning of 1990´s with a great enthusiasm. The reasons can be very simply and easily explained on the example of Czech Republic. Former sports games for pupils, students, persons with intellectual disability, were permitted with governmental moral and financial support and could be developed only with respect to “normative philosophy” and only on regional level. “Normative philosophy” means - only the best athletes could continue to a higher level of competition, there were minimal chances to participate for persons with more intensive disability. Then the Special Olympics philosophy was quickly accepted as the educator’s reaction to the former system which was oriented only on the “better” athletes with mild intellectual disability. Educators and coaches wanted to do more for potential athletes of all abilities. Regional and district level means – competitions, sports meetings were organized only on local, district level, there were no chance to hold national games or participate in international network. The educator’s reacted quickly because new opportunities became a challenge to improve sports of persons with intellectual disability on higher, systematic approach including international level. Quick changes were linked with the level of education of teacher/educators. At that time, under the school law (1976-1990), only Masters’ level graduates either in physical education or in special education could be fully employed in special schools, special centres, residential centres as the teachers, educators. The Special Olympics Unified sports program became attractive due to traditional sports games orientation in the Central European countries and in the Czech environment context, too. Participation of Czech SO team in WSSOG (1995) in volleyball and football unified event seemed to be great challenge for future field unified sports development as well as organizing European unified volleyball tournament (2002) and European unified football tournament in the city Zlin (2002).

Despite the fact that within the framework of the Czech Special Olympics movement the principle of unified sports has been known and successfully implemented since 1995, despite the school legislation in the Czech Republic promotes inclusive education, the above-mentioned comprehensive models of UNIFY have not been expanded in schools in the Czech Republic. One reason is that inclusive schools (teachers, directors) with students with a mild or moderate level of intellectual disability are not aware of this possibility, and that out-of-class activities are based on unpaid volunteering. Thus, it happens that these “inclusions” in the so-called academic subjects is stressed, where their positive experiences of success are very, very questionable, do not have the opportunity to manifest themselves in another area, namely physical (Titzl, 2016, pp. 261-293). While establishing unified groups or clubs directly at the school is not so demanding. Ideal activities in unified format is just football of 5 or 7 players, bocce, table tennis, hiking and outdoor camps, Czech national sport “throw-over”. These unified sports combined with healthy fitness orientation are very common in Czech Special Olympics National Programme (Válková, 2016; Válková & Krejčí, 2016).

Unified Football

Characteristics and the Development of Unified Football

Football (American title soccer is officially change – www.specialolympics.org-sports) is one of the most popular SO Unified Sports. The program is mainly played in a modified, small-team format of 5 or 7 players. Football development is supported by FIFA (Fédération Internationale des Football Associations) and UEFA (European Union of Football Association). (See www.UEFA.com. // Grassroots football, Disability football panel). The report Conclusion from the 1995 SO World Summer Games, Unified football competition (Dublin SO seminar 1997) highlighted the increase in Unified Football. Statistics of the unified football teams participated in the World Summer Special Olympic Games were as follows:

- in 1991 – USA (Minnesota) - there were 15 teams of Unified football, only from the USA;
- in 1995 – USA (Connecticut) - there were 21 teams from 15 countries of different continents (eg.: from Argentina, Germany, United Kingdom, Hungary, Czech Republic, USA–CT, USA–NH, etc.);
- in 2019 - United Arab Emirates (Abu Dhabi) – there were 14 female teams and 25 mixed male-female teams.

According the SO philosophy related on principle of relativity the SO team sports divisioning system is created on the Individual Skills Test assessment (Unified Sports, 26.5.2006). The results created the bases of highest commendation in regard to equality in ability. The balanced dominance between athletes–partners within the team are proclaimed. The appropriate activity and cooperation are considered as valuable attitudes, inclusion not only for unified sports participants but as the signal for public awareness. The founding of different activities, efficiency and dominance between athletes–partners according to different competitive situation has been provoking discussions related to future development of understanding and realization of the principle of "meaningful involvement" theory. It was the reason the report Conclusion from the 1995 SO World Summer Games, Unified football competition (Dublin SO seminar 1997) recommend change rules, mainly in the direction of partners activity restriction. A similar discussion occurred during European Unified basketball seminar in Switzerland in 1997. But the discussed domain was not relevant with one of the main principles of "meaningful involvement". The principles were included, in the first time, in SO sports rules followed Unified Sports Handbook (1992).

Individual skills tests

The system of Individual Skills Test (IST) creates the obligatory part of unified sports training and competition, as *Members of a Special Olympics Unified Sports team should be able to demonstrate fundamental skills and strategies of the sport* (SOI, 2004, p.11). The system of IST was developed for assessment of every teammate and every team sport (SOI, 2003, p.22), including unified sports. Hypothetically the success of the team games can be linked with individual skills. A balanced team should be composed from teammates with similar achievements from the aspect of IST both for high level of achievement, team cooperation among athletes/partners and for safety during match scrimmage (SOI, 2003, p.15). The most of those tests have been developed on the bases of AAHPER test. Exact SO IST system, administration and application are described on www.specialolympics.org. However, the exact data related to origin, procedures of standardization are missing. There is lack of research information dealing with a procedure of assessment of SO IST in general. Only validity and reliability of SO IST in volleyball was assessed. Downs and Wood (1996) examined 130 SO volleyball players. Volleyball skills assessment test consists of the following - forearm pass, spike, set, serve. Again, volleyball skills measurement is used as a predictor of individual team success in SO volleyball competition. Castagno (2001) was focused on the changes in unified basketball IST of teammates (with and without intellectual disability). All of them participated in 8 week after-school unified basketball program. The improvement of IST was found in all teammates. The findings of improvement of IST both athletes and partners due to unified system are important. Additional results supported the social benefit of unified sports.

The football IST reliability assessment was realized by Saňák (2002) for use in Czech language and environment purposes. The changes in SO football IST results and motor fitness variables after 8 week unified football training were investigated by Özer et al., (2005). The different picture of improvement in determined sub-tests was found in athletes–partners results. The general benefit in social behaviour of SO unified football training was presented.

The success of a team in match-games is linked with not only with individual skills but with executive functions “decision making” and “problem solving”. These are basic problems in SO team cooperation both in general and in unified design. Information about IST achievements and relation to competitive achievements in match are still waiting for serious research.

Definition and principles of “meaningful involvement” theory in SO unified sports

“Special Olympics unified sports is a program that combines approximately equal numbers of Special Olympics athletes and athletes without intellectual disabilities (partners) on sports teams for training and competition” (www.specialolympics.org, Unified Sports, 26.5.2006). The principles of meaningful involvement in team sports were systematically developed since 1992 in three periods. The principles of meaningful involvement were first defined in Unified Sports Handbook (1992, p.25):

1) *all athletes shall compete without causing undue risk of injury to oneself or other participants;*
2) *all athletes shall be able to participate according to the rules and conditions of competition for that particular sport;*
3) *all athletes shall have the ability and opportunity to contribute to the performance of the team, without significant accommodation by any person on their team*.

The second period was touched with discussion of results reports and perception of unified tournaments. The most important basic information was presented in Conclusion from the 1995 SO World Summer Games, Unified football competition (Dublin SO seminar

1997). Exact data dealing with activity and dominance athletes/partners showed that athletes scored goals on the level of 48% and assisted to goals in 38%. Partners scored in 55% cases, but in 83% of winning goals. The similar discussion was running during European Unified basketball seminar in Switzerland in 1997. The conclusion recommended changing rules, mainly in direction of partners activity restriction.

Eventually this recommendation was rejected as supporting negative labelling of athletes/partners and stigmatization of low-high abilities of teammates, and, more important, not relevant with one of the main principles of meaningful involvement. Recent effort of SO policy is to support through the Unified sports program the ideas of inclusion and higher ability of athletes who may have avoided the perceived stigma of SO such as easy motor activities for severely handicapped (Block, 1992). Next, the rules and internal material from European Unified sports workshops changed the terminology for better inclusive feeling and no labelling *(Appropriate terminology: sportsman -athlete –partner = players, teammates)*. The check-list of available team or dyadic unified sports was published (SOI, 1997; SOI, 1999; SOI, 2002) and the principles of meaningful involvement were stressed in a divisioning system of competition (Dublin, 1997; Zlín, 2002; SO rules, 1999, 2003).

Recent explanation of principles of meaningful involvement is as follows: (Special Olympics Unified Sports, Special Olympics, Inc., 2003, www.specialolympics.org, p. 16):

1) *teammates athletes shall compete without causing undue risk of injury to themselves;*
2) *teammates participate according to the rules of the competition;*
3) *teammates have the ability and opportunity to contribute to the performance of the team;*
4) *teammates understand how to blend their skills with those of other athletes, resulting in improved performance by athletes with lesser ability.*

Through meaningful involvement it is essential to protect the integrity of Unified Sports, it is intended to govern the quality of interaction and competition within a team. It means every teammate will have a chance to play adequate role, have opportunity to contribute to the team achievement, have chance to play important and valued role in the team. Athletes and partners compete together as a team without advantages of athletes or restrictions of partners. Activity and cooperation are shared by all teammates related to their role. Players with and without disabilities compose the team. Team atmosphere is supported by coaches' and officials' approach and behaviour (no labelling in language, on bibs). Meaningful involvement is not achieved by teammates (usually partners) who have superior sports skills, control most aspects of the competition, or concentrate the activity of the team on themselves. The recommendation related to SO Unified rules can be considered as the principle of "meaningful involvement between athletes with and without disabilities" theory which means athletes and partners compete together as a team without advantages of athletes or restrictions of partners. Teammates became the friends for out-training and out-competition time, as well.

The issues presented above were the reason that since 2002 a team of university students – Czech SO volunteers has been engaged in the domain of unified football in the context of health-oriented fitness, individual skills and cooperation between athletes and partners within their bachelor and master theses. The fulfilment of the principle of meaningful involvement can be a marker of suitability and benefit of inclusive approach in SO. From the second-hand unified sports can be available model for complex rehabilitation.

Research in athletes – partners involvement in unified football

Design of unified football pilot study 2002

The pilot research study was oriented on three issues:

a) assessment of exact data of Individual Skills Testing (IST) in Czech environment as the background for next study;
b) the verification of the observation system for the evaluation of cooperation between athlete – partner;
c) the verification of the index of participants activity and cooperation in unified football competition.

a) The process of *standardization of the IST* for Czech SO population was realized for both levels of testing: low ability individual level and high ability team level (Special Olympics Unified Sports, Special Olympics, Inc., 2003 www.specialolympics.org). Both levels consisted of skills: dribbling, passing, shooting, but on the different level of difficulty. Scoring of IST results showed time, points, etc. related to norms of the manual. The higher amount of points means higher level of skills. Determined categories, content of the tests, administration were described in SO Unified Football rules (SOI, 2003).

The complete list of all six tests and assessment procedures were included in Czech manual (Saňák, 2002). The text of IST went through a process of translation–retranslation. Test-retest reliability assessment was realized in 27 athletes with moderate mental disability and 23 partners. A two days break was adhered between pre and post measurement. All of teammates participated in unified football training and competition longer than two years. The tests for low level ability appeared too easy for partners, even for athletes able to participate in football match. All of them were able to achieve 93% of the score points in skills as so as in summary (dribbling – 51.1 points from 60 maximum, shooting – 69.6 points from 70 maximum, run and kick – 38.2 points from 40 maximum, partners – 170 points total which is maximum). High level of the team IST could better distinguish differences in football skills of all teammates. The stronger index of reliability was demonstrated in partners group (on the level of 0.01 statistical significance) than in athletes' group (on the level of 0.05 statistical significance). Football IST is complex (especially high level for team unified) and can be considered as relevant for assessment of potential participation in football match. The test of "passing" seems to be the strongest variable of the complete test battery and most important variable for potential participation in football match and team cooperation.

Table 1. *Recording System of Movement Act Observation*

MARK	MOVEMENT ACT
→+ (No)	Pass successful to No
→– (No)	Pass un-successful to No
+	Getting/fighting ball
–	Losing the ball
V+G	Successful shoot (goal achievement)
V+	Successful shoot on the gate (not goal)
V–	Un-successful shoot on the gate
f+	Player fouled
f–	Player was fouled
O	Yellow card

b) *Observation* (including our "activity" and "cooperation") is applied in situation where there is necessary to discover behaviour of participants in real environment (Table 1.) *Behaviour is usually coded as to what occurs, when, how often, and how long* (Thomas, Nelson, & Silverman, 2005, p. 341). The selected category (items) for observation accepted former experience in pilot study. Direct observation was provided on the basis of Flanagan CIT (Critical Incident Techniques). Flanagan's Critical Incident Technique appeared in the 1930's (working – job psychology domain) (Flanagan, 1954). CIT principle was used frequently during the period of attempts to assess teaching–learning process (Flanders, 1970; Lewin, Lippit, & White, 1970; Piéron & Cheffers, 1973) called as FIAS or CAFIAS evaluation system (Flanders Interaction Analysis System) or CBAS (The Coaching Behavior Assessment System). CIT principle has been commonly used in all domains when process has to be evaluated, particularly in team sports competition analysis of process or statistics assessment of success of players or teams. CIT is based on the simple principle of bi-polar determination: category/incident exists – or category/incident does not exist. Every incident during the process regarding to the aim of process is precisely formulated and recognized by basic criterion: positive – negative, promoting – interfering, verbal – nonverbal (etc.). Incidents/categories can be evaluated on the level of time spending or basic level of statistics: scaling (making ranks, orders), counting (making summary, frequency, percentage, indices, etc.).

Related to football IST the incidents dribbling, pass, shooting, ball loosing and goal achievement were selected and recorded. The incident "pass" was recorded and analysed in relation: pass to athlete – to partner, pass received the ball from either athlete or partner. The incidents dribbling, pass, shooting with additional ball loosing and goal achievement were considered as the items of teammates activity. Recognizing of pass to athletes – to partner, receiving the ball from athletes–partner was considered as an item of teammate´s cooperation.

Before using the instrument in this study the categorical observation system was verified during various unified football tournaments in period 2003-2004, in 26 matches. Two pairs of SO volunteers, APA students, assed the identical team, totally 11 pairs (22 persons) were trained and included in proved process for two years. Persons in observing pairs were changed match per match. Analyses of records from each match were realized during two days after the match. Items of activity (dribbling, pass, shooting, ball loosing and goal achievement) were processed on the level of descriptive statistics. Each observed and recorded item represented one point for total sum. Concordance between pairs evaluated by correlation coefficient on the level 0.01 varied from r = .44 in first evaluation to r = .74 in the end of verification process. All pairs were able to achieve coefficient r = .71. Average value of the coefficient was r = .67 (Holušová, 2004). Items of cooperation were not statistically processed for various additional aspects like tactics of the team, different time players spent on the pitch in minutes. The coding system including observers training, creating manual for unified clubs had been developed until 2016. Recent valid system of players behaviour in unified football is presented in the Table 1.

c) *Verification of the index of participants activity and cooperation* in unified football competition related to the theory of "meaningful involvement" was processed during several unified football tournament up to 2016, too, by trained observers. Index of activity (IXA) was worked out as a summary of positive points (pass, dribbling, shoot, goal) minus negative points of item lost the ball. Higher number of IXA points means higher activity, higher team role and player´s dominance. The intensity of cooperation between the athlete and the partner is calculated as the sum of actions taken (from) and sent (to).

The conclusions of the pilot study, outside the verification of methodology and process, revealed other issue:

- Differences in activity of athletes–partners were found in relation with the winning – lost matches as well as in relation with the performance level of the teams. In winning matches partners behave more cooperatively, in loosing matches partners behave more dominate in shooting as well as with yellow cards (Válková, 2003). The results of the pilot study were not in accordance with theoretical concept of principle of meaningful involvement and proclaimed request for realization in practice.
- ISTs are the basis for the teams divisioning into adequate groups. Do the results of the IST fitted the activity and cooperation in the match?

The findings of the pilot study provoked follow up research during next years.

Comprehensive research model of unified football

The main goal was to assess the principles of meaningful involvement theory of SO unified sports on the background of Unified Sports 7-sided football. Sub-goals are:

- to assess the athletes–partners´ results of IST and activity during the match,
- to assess activity of athletes–partners in winning - loosing matches,
- to assess the items of cooperation between athletes–partners in winning - loosing matches.

METHOD

Participants - teammates

Participants of the investigation were recruited from two unified 7-a-side teams participated in UEFA week tournament in May 2016 (Table 2). Winning unified team (WUT – team was winning in all 3 matches) compost from 9 players (5 athletes with F 70 diagnosis of intellectual disability, 4 partners with secondary or college education). The average age of athletes was 31 years, average age of partners – 29 years. Athletes were interested in football about 8 years, in unified football 6 years. The partners played football at interval 14–34 years (average 22 years), unified football 6 years. The teammates played together 6 years, they participated in several international tournaments. The team is balanced in similar age, and football experience as well as unified football inclusion.

Loosing unified team (LUT – team lost all 3 matches) consisted from 10 players (7 athletes with F 70 diagnosis of intellectual disability, 3 partners with college education). The average age of athletes was 16 years, partners 34 years. All of them participated in unified football from 1 to 3 years. Partners participated in unified football the same time, but they had approximately 21years experience with general football (from 14 to 30 years). The team was not adequately balanced from age and football experience. The team began the unified sports career and suffered with lack of competition chances. By reason that the goalkeepers of both teams were athletes (related to SO unified rules recommendation) competition strategy of both teams was based on defensive position of partners and attack tasks of sportsmen.

Instruments of data collection

Football IST battery was applied for assessment of the potential level of achievement of all teammates. All of six tests were used (3 for low ability individual level, 3 for high ability team level), together with 6 examinations in the battery. Both levels of IST consisted from basic skills: dribbling, passing, shooting, but on the different level of difficulty (SOI, 2003). Used observation coding system for assessment of unified football match is described in the part "pilot study".

Table 2. *Characteristics of Participants of Winning (WUT) and Loosing (LUT) Teams (WUT N = 9, LUT N = 10)*

Winning team (WUT)					Loosing team (LUT)				
No A-P	Age	ID	FEx	UEx	No A-P	Age	ID	FEx	UEx
A 1	28	F 70	8	6	A 11	15	F 70	0	1
A 2	39	F 70	8	6	A 12	16	F 70	0	3
A 3	39	F 70	8	6	A 13	15	F 70	0	2
A 4	20	F 70	6	6	A 14	18	F 70	0	1
A 5	30	F 70	8	6	A 15	16	F 70	0	2
					A 16	16	F 70	0	3
					A 17	16	F 70	0	1
M	***31.2***		***7.6***	***6***	***M***	***17.6***		***0***	***1.9***
P 7	44	MA	34	6	P 18	48	MA	30	3
P 8	31	col	25	3	P 19	20	col	14	1
P 9	20	col	14	6	P 20	35	col	20	3
P 10	21	col	14	6					
M	***29***		***21.7***	***5.25***	***M***	***33.7***		***21.4***	***2.9***

Note. No A = code number of athletes: No P = code number of partners; M = average; ID = code of level of intellectual disability; FEx = football experience in years; UEx = unified football experience in years; col = college or secondary school education; MA = master education.

Procedure

The project was realized during "UEFA week" (May, 2016). The research project was proved by Ethical Commission of Faculty of Sport Studies, Masaryk University in Brno including a written consent letter signed by partners and athletes or their guardians.

All teammates were assessed with IST (morning). Testing was professionally organized by 18 trained students (sport management). Standard conditions for measurements related to SO rules were saved. All teammates were directly questioned about basic life-span data (age, sports experience, period of unified football participation). Athletes were asked with assistance of coaches in case of a necessary situation. Competitive matches started afternoon and continued for next 2 days. Playing system of tournament (afternoon) was realized "each team against each one" – together 3 matches were recorded and analysed. Playing period of one match was divided in two periods per 15 minutes (clear time). Matches were judged with officials on national grade. Players were recognized with T-shirt numbers without any labelling athletes/ partners.

Each match was evaluated with three trained observers – students. They were trained in CIT system of observation and familiar with the process of unified football, proficient and interested in observation due to their study orientation. Three observers assessed one identical team during the tournament: one pair of observers and one "Dictaphone speaker". The "dictaphone speaker" worked independently out of pair and reported the match with respect of categorical scale, it means bib number of players and brief description of activity item. In a system of pairs one of the observers dictated the items of athletes/partners activity to a second person recording the items in special marks directly with "pencil-paper" (Table 1). The movement of players was not too dynamic and the size of 7-side football playground created appropriate condition for observation. It means, no problems occurred during assessed process. Recording was provided in running time of the match.

Data evaluation

Points from six tests of IST were summarized related to the Unified handbook (SOI, 2003). A higher number of IST points means higher level of skills. Those findings were worked out only on a frequency–counting bases: summary, frequency, percentage. The data analyses of CIT items were relevant with proved process (Holušová, 2004). The records and reports of only WUT and LUT were included in the study. Observer who recorded the data in a written form checked the data with Dictaphone record and the collected final version of record in two days after tournament. Independent examiner on observers summarized raw data recorded in running time into the category items, player per player. Every record of observed items represents one point. Complete data were evaluated on the level of descriptive statistics (Thomas, Nelson & Silverman, 2005): means, percentage, and standard deviation of IST and IXA.

RESULTS

Summary of average teams results (not individuals) are presented. The similar average of IST points were found in both teams, WUT M = 470 (SD = 62.4), LUT M = 467 (SD = 53.1). But average scores of athletes and partners were very different. The order of athletes/partners in average IST scoring was the following: P WUT M = 524, P LUT M = 502, A LUT M = 432, A WUT M = 417.

Between WUT partners and athletes there were 100 points discrepancy despite their long term together in football experience. WUT athletes achieved the least score even though they participated in winning team. The difference between athletes and partners in LUT was 70 points and they were in the middle of ranking the average points.

The average IXA of WUT players together was M = 42.6 (SD 17), LUT players M = 45.4 (SD 23.1). The findings indicate greater differences in activity items among teammates in LUT. Findings are underlined with the order of average IXA of partners and athletes: P LUT M = 63.7, P WUT M = 55.0, A WUT M = 32.2, A LUT M = 27.2. The highest IXA of P LUT is in accordance the thesis that higher IST can be in relation with higher activity since differences between LUT and WUT partners are minimal. The gap between partners and athletes IXA is evident in both teams while average IXA of WUT and LUT athletes are similar. Summary of items of activity and cooperation between partners and athletes is presented in the Table 3.

Table 3. *Summary of Items of Activity and Cooperation of Winning (WUT) and Loosing (LUT)*

	Items of activity							Items of cooperation			
team	L-ball	pass	dribbling	shoot	goal	IXA	IST	Ps to A	Ps to P	R from A	R from P
WUT – athletes											
M	12.2	25	9.6	7.2	2.6	32.2	417	7.2	17.8	8.8	23.8
WUT – partners											
M	13.3	42.7	20.7	4.7	0.5	55.0	524	26.6	16.7	26.2	20.0
Team *M*	12.7	33.8	15.1	5.9	1.5	42.6	470	16.9	17.2	17.9	21.9
SD							17.2	62.4			
LUT – athletes											
M	14.1	23.6	10.6	6.0	1.0	27.2	432	10.1	13.3	10.8	17.8
LUT – partners											
M	14.4	53.7	19.7	3.7	1.0	63.7	502	39.7	14.0	30.7	17.7
Team M	14.2	38.6	15.1	4.6	1.0	45.4	467	24.9	13.6	20.2	17.7
SD							23.1	53.1			

Note. WUT = winning unified team; LUT = loosing unified team; M = average; SD = standard deviation; L-ball = lost ball; IXA = index of activity, points; IST = Individual skill test, points; Ps to A = pass to athlete; Ps to P = pass to partner; R from A = pass received from athlete; R from P = pass received from partner.

The percentage of lost ball item varied from 12% to 14,4% in both WUT athletes, partners and LUT athletes, partners. Passing and dribbling activity was the priority of partners in both teams: passing in 50% of activity and dribbling in 20% of activity.

Partners presented about 50% higher achievement in items of category dribbling which is probably relevant to skills and higher dominance of partners. The frequency of pass to athletes from partners and receiving the pass from athletes to partners is higher than opposite direction of passing. There is no doubt the athletes prefer passing to partners, primarily athletes of WUT (71.8%) as well as athletes of LUT (56.7%). Shooting and goal records seem to be priority of athletes. It means an attack strategy was delegated to athletes, maybe partners accepted defensive responsibility and cooperation with athletes. Athletes achieved 13 goals, partners 2, but both these goals were winning goals before the end of the match. The picture of activity items in LUT teammates is a quite similar. Relation between IST and IXA ranking are documented in the Table 4.

Table 4. *Ranking of Results in Individual Skill Tests (IST) and Index of Activity (IXT) of players (N = 19)*

		IST		IXA	
No A-P	team	points	order	index	order
P 8	WUT	545	1	54	5
P 9	WUT	535	2	62	3
P 18	LUT	5104	73	1	
P 19	LUT	510	4	46	9
P 7	WUT	5104	53	6	
P 10	WUT505	6	51	8	
A 16	LUT	495	7	25	13
P 20	LUT	485	8	72	2
A 12	LUT	475	9	57	4
A 15	LUT	465	10	29	11
A 1	WUT	450	11	53	6
A 5	WUT	450	11	41	10
A 17	LUT	415	13	22	15
A 3	WUT	410	14	25	13
A 13	LUT	405	15	25	13
A 2	WUT	405	15	22	15
A 14	LUT	385	17	14	19
A 11	LUT	385	17	18	18
A 4	LUT	370	19	20	17
M		**484**		**40**	
SD		59		19	

Note. No A = code number of athletes; No P = code number of partners´; IST = Individual skill test, points; IXA = index of activity, points; WUT = winning unified team; LUT = loosing unified team.

DISCUSSION

The relationship between football skills results (IST) and activity (IXA) was additionally processed with Spearman "order" correlation test (index of correlation was 0,69). Even without statistics there is visible the higher level of partners. The finding can influence the match performance. The IST results are not in direct relation with IXA among players–partners and separately among players–athletes´ group, but they should be considered as positive background for teammate's assessment. The results can better distinguish differences among partners than among athletes as the athlete's decision making process during the competition can cover the level of individual skills. IST relation with cooperation items could not be assessed as visible preference of athletes was oriented on partners. Partner's priority was to pass and initiate with the athletes. But with logical reflection, the discrepancies between partners and athletes within both teams show doubts about analogous results in situation of higher number of participants in separate partners group and separate athletes' group. This idea can be an opportunity for future research.

The issue of "individual skills tests" against "the team performance" is discussed among general sports training specialist. This is because the "match" performance is composed from fitness, individual skills and "team cooperation" based on anticipation, problem solving or decision-making process. The decision-making process is the weak part of team participation of Special Olympians, yet. There are no findings related to this topic.

The dominance of the partners, particularly in LUT, can be explained either by "age reason" or general football skills reason or personal approach which were not investigated. Probably the potential skills teams prefer strategy of athletes attack positions and partners defensive tasks. This strategy can influence the shooting activity of athletes and goal records. However, in loosing situation, partners are more active in goals as well. High number of sending passes of partners to athletes can be relevant with the athlete's offensive strategy. Athlete's priority in passing to partners can be linked with their confidence to the partner´s skills and abilities, with their pragmatic strategy of athletes. This includes to win as the team, to be part of it despite of the lack of personal success. Another explanation of the finding can be linked with the idea of higher skills of partners, as well as higher activity and confidence or beliefs of athletes in higher ability of partners. The results of IST seem to be important for activity and strategy of competition and secondary, for activity and cooperation of teammates. Also, opposite – partners can give the athletes a chance to play and score which is in accordance of principle of meaningful involvement. The phenomenon of possible sympathy-antipathy among teammates was not investigated but in a very small group this phenomenon cannot be expected. Balance activity and cooperation is usually in the case of winning competition process. In case of critical situation then partners become more dominant, active, or aggressive. It means – the balance of activity and cooperation between athletes and partners as the principle of "meaningful involvement" theory is polluted with social role expected both athletes and partners. New questions appeared: Is the principle of meaningful involvement realistic or only virtual reality? And – in conclusion: "What is the priority for athletes – to be in balanced items of activity/ cooperation, dominance or – to play together, to be part of it and be happy?"

Despite of the numeric data, despite the fact that research on social role, subjective feelings (joy – sadness) was not realized, at each tournament you can see the effort and team atmosphere, talking with each other, applaus of spectators, expectations of awarding ceremony, joint photo, etc. It is meaningful involvement in community due to model of unified sports.

CONCLUSION AND RECOMMENDATION

Football IST is relevant with potential performance in competition (in Czech Republic SO environment, too). Using only the part of high level of IST battery (team tests) is enough for evaluation of player´s skills (athletes, partners). IST results are not in direct relation with activity items in a match but they seem to be important background for divisioning of teams complemented by experts' observation. The appropriate age in team composition should be respected in team sports. High level of IST and IXA documents the dominance of partners and typical competition strategy: attacking of athletes, defending of partners. Cooperation among teammates was assessed with sending pass to athletes/partners or receiving pass from athletes/partners. The priority of selecting partners from athletes and athletes from partners is marked and probably linked with partner´s skills. A loosing match atmosphere provokes the dominance of partners. Further research should focus on comparing SO unified results with players cooperation in regular teams. The visible emotional and social benefits should also be supported by research. The prerequisite is that the whole UNIFY system will be extended to sport clubs and schools.

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SPORTIZATION OF PHYSICAL EDUCATION: RUSSIAN EXPERIENCE

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SUMMARY

In modern conditions, contrary to the traditional practice of educational institutions focused on educational results in terms of subject, cultural, professional competencies and the creation of a health-saving environment new conceptual approaches and innovative technologies are being formed that allow recognizing students' health as a fundamental educational object. The need for shifting the emphasis from creating a health-saving environment of educational institutions to building a health-forming educational space, which ensures the development of health-forming values and meanings, has already been recognized. The authors trace the relationship between sportization of physical education and health-forming educational space.

Key words: physical education, professional competence, sport

INTRODUCTION

The health-forming educational space of an educational institution should directedly stimulate adaptive capacities of students by strengthening their health, contributing to their productive activity, increasing their health-forming competence, as well as successful adaptation and socialization in the educational institution. From the standpoint of health formation, sportization of physical education can be considered as a new research methodology in the field of education and as an innovative technology that allows the development of pedagogical practice.

The system of physical education in Russia needs to be updated both in terms of content and technological plans. According to Grigoriev, "outdated teaching methods in the lessons of physical education, its poor material base, lack of training, limited hours for training and less effective forms of lessons in sports do not make it possible to have a serious impact on comprehension of sports culture and different types of team sports that bring health and socialization experience for students" (Grigoriev, 2015). At the same time, the health status of the younger generation is alarming for health workers, teachers and parents.

Sportization

One of the ways to solve the aforementioned problems of health and sports education of students is sportization as an active use of sports technologies, competitions and elements of sports in the educational process of schools and universities. Sportization is considered as the modernization of physical education and training, as well as the creation of conditions for the development of youth sports and its accessibility.

Experiments and pedagogical experience show that increasing the effectiveness of physical education through sportization helps to train healthy, educated, and tolerant people capable of making decisions, predicting their consequences and taking responsibility for the result. A special role in the emergence of these qualities belongs to team sports used for the sportization of sports schools in Russia.

Attempts to solve the issue of physical education were undertaken by many scientists, experts, managers and teachers in our country. The works of L. Lubysheva, V. Lyakh, V. Balsevich, A. Bondarchuk, P. Grigoriev, S. Gordon, N. Kostrova, R. Raevsky are dedicated to "the sportization of physical education as a key problem". The pedagogical experiment of Balsevich showed not only a significant improvement in the physical fitness of schoolchildren but also "a radical change in the attitude of adolescents to physical education classes" (Lubysheva, 2015). Shchetinina (2009) wrote and published the manual entitled "Sportization of Physical Education". Bondarchuk (2007) also published a manual on the sportization of physical education. Grigoriev (2015) investigated the issues of sportization of physical education in a comprehensive school. Gordon published the scientific-methodical manual "Sports training at school", and Lyakh proposed guidelines for the restructuring of physical education in a comprehensive school (2008). Raevsky (2008) considers the sportization of physical education as an important issue of our time. Lubysheva revealed the essence of sports education at school (2006).

According to Natalov (2005), an individual approach is necessary in the selection of physical activities for schoolchildren with a different type of functional status of their body. In the context of a mass school, it is possible to build up certain pedagogical activities so teachers and students are personally active in building their own education programs (both in terms of training and development). This involves joint (student-teacher-parent) project activities aimed at the student's self-development, a joint choice of methods, means, pace, etc. for the implementation of this activity, a joint selection of goals and objectives of self-development.

The aim of sports-oriented physical education is to provide schoolchildren with the freedom to choose exercises, their intensity and performance, as well as the possibility to change the type of physical education or sports activities based on awareness of individual physical abilities and potential opportunities.

It should be noted that Balsevich (2003, 2005) when talking about new tasks of physical education, believes that all forms of physical education in the school should be focused on the upbringing of a harmonious physically active person, which can be achieved through knowledge and the mechanisms of interiorization of the value potential of physical education, as well as through instilling conscious requirements for physical activity.

Nevertheless, the general issues of the scientific and methodological approaches to physical education are connected with the absence of scientifically based, universal methods of stimulating students' motivation for physical exercises with respect to individually-needed and socially expected aspects of the chosen sport.

A radical change in the already rudimentary traditional system of physical education can overcome this problem (Balsevich, 2002; Komkov, 2002; Lubysheva, 2009; Stolyarov, 1997; Vavilov, 1995). In this regard, in the 90s, Balsevich (1998) and Lubysheva (1994) formulated options and forms for constructing physical education classes, the content of which was based on the converted phenomenon of sports training substantiated by the masters of Russian physiology, namely Farfel (1955), Krestovnikov (2006), Zimkin (1975). The concept was called "sports-oriented physical education" (Lubysheva, 1994).

The innovativeness and ideological basis of sports-oriented physical education consist of designing conditions that exclude undifferentiated development of physical education values in students, and, at the same time, show the near future of their qualitative and quantitative physical improvement in compliance with personal motives, characteristics and claims of an individual student.

A review of advanced domestic and foreign educational technologies aimed at enhancing students' health allows us to judge the high efficiency and prospects of sportized and sports-oriented forms of work with children and youth, since this methodology allows for positive adaptation shifts and increases motivation for sports self-improvement and giving up bad habits.

Sports-oriented physical education in many regions of Russia has found its followers and successors. The practical value of these ideas is in the reproducibility of each educational institution at the expense of its own infrastructure (Balsevich, 1998, 2006, 2009; Lubysheva, 1994, 2009, 2010).

The positive effect of this scientific field is shown in a huge number of long-term pedagogical research (from 1978 to 2010) in Russian cities: Perm, Naberezhnye-Chelny, Tchaikovsky, Surgut, Omsk. Many studies are ongoing at present, in the publications there are facts of a positive effect of sportization of physical education in educational institutions of various types, which allows students to improve physical condition, strengthen their will, actively abandon health-damaging habits (Balsevich, 2002; Belova, 2009; Fonarev, 2009; Lubysheva, 2008; Markova, 1983; Progonyuk, 2000).

We consider the health formation as a stable positive dynamics of the morphofunctional qualities and personality traits of a person in implementing his or her biological and social functions. The semantics of health-forming activity in the context of a theory of activity is represented by a combination of four basic semantic meanings, which can be briefly described as: a specific way of life; holistic education, socio-medical-pedagogical system, methods and conditions as well as the result of maintaining and improving human health in all its diversity. A theoretical study showed that the concept of a healthy activity in pedagogy is relatively new and in modern conditions its significance is exacerbated.

The healthy educational space of a school is considered as:

- a multi-level space that includes the influence of the federal and regional levels on health preservation of a primary school student;
- a multidimensional space, the main aspects of which are: pedagogical, educational and health-forming;
- a multi-vector space, where the vector of health-forming activity coincides with the vectors of all other types of activity, and itself is represented by a set of directions for the formation of meta-subject health-forming competencies.

The author's concept of the health-forming educational space of the modern school is based on the following provisions:

The mission of the comprehensive school is changing through the consideration of the educational space as an open, mobile territory of active socialization of health-responsible subjects (teachers, students, parents) interacting with the physical and socio-cultural environment, in which conditions are created for the formation of meta-subject health-forming competencies, self-realization and self-expression personality.

The health of students becomes a fundamental educational object and a meta-subject educational result.

The core of the school's health-forming space will be a system of students' physical education, in which differentiation of developmental effects is carried out through comprehensive monitoring of the current psychophysical status and the adaptation of the student's functional systems to optimal physical stress, as well as the creation of conditions for the realization of their right to choose types and modes of motor activity in the third lesson of physical education and after school hours.

The meta-subject of health formation is realized through interdisciplinary integration and the integration of lesson and extracurricular health-forming, cognitive, developing, self-educational activities of subjects (teachers, students, parents).

The criterion of the teacher's professional competence is not only information ownership but also the ability to organize a health-forming space that creates the conditions for positive dynamics in the health status of students.

The following principles became the guidelines for constructing the school's health-forming educational space:

1. **Proactive compliance with educational standards, the mission of the comprehensive school and the educational needs of the subjects.** The implementation of the principle involves predictive and critical design of a health-forming educational space taking into account legal acts of various levels, school mission provisions, educational and health-related needs of educational subjects and society, as well as a comparison of educational results with the declared goals and experience of other domestic and foreign educational organizations.
2. **Environmental friendliness and cultural conformity.** It involves the multi-vector, integrative and embedded nature of space in natural, civilizational and educational structures of a higher order and the involvement of its subjects in various social relations and social practices for the formation of health, which stimulate the spiritual and physical development of subjects of school space. The strategy of organizing the space should be guided by the interaction of the school with related social institutions and partners.
3. **Natural conformity and the humanistic lability of structural-functional relations.** It provides for the inclusion in the educational process of heterochrony of individual age-related ontogenetic features of the subjects and corresponding educational, developmental, health and other influences, as well as declares the self-worth of subjects, their right to freedom of choice and the humanity of pedagogical influences. It updates a flexible set of educational and health-improving conditions that allow subjects (teachers, students) to develop taking into account their individual characteristics. The principle

involves the inclusion of subjects in activities that are optimal for their personal characteristics, motives, interests.

4. **Health-forming validity of educational technologies and conditions.** The principle is based on the need for detailed monitoring of the status of students on the basis of pedagogical, psychological, sociological and medico-physiological studies as a measure that determines the conformity of pedagogical and other means, methods, conditions and results to the declared goal of forming meta-subject health-related competence of students.
5. **Stimulating the psychological mechanisms of responsibility for one's health, personal development and partnership.** The implementation of the principle consists in the need to saturate the educational space with activities, relationships and incentives (situations ("success", "failure", etc.), symbols, contradictions) as "triggers" of the student's health-forming reflection and personal development, and also partnership and exchange of meanings of the health formation of the subjects (student - teacher - parent) and society as a whole.

The purpose of education as a set of requirements of society in the field of spiritual reproduction and as a social order is a determinant (prerequisite) for the emergence of pedagogical systems. Within the framework of these systems, it becomes an immanent (inherent) characteristic of education. According to Anokhin (1975), purpose while mediating real activity not only characterizes its overall result but also determines the way and nature of human actions. The subjects of the pedagogical process (teachers and pupils) are the unity of purpose and activity, the "mode of transition of society to the individual" and vice versa.

In the goal-related component of the project model of the system of physical education aimed at forming health in students, there is a parity of the following components:

- pedagogy as a unity of positive transformations of the personal characteristics of students;
- socialization allowing a child to comfortably coexist and interact with society;
- education that forms meta-subject competencies of a student;
- health formation considered as a stable positive dynamics of morphological and functional qualities of the body and personal traits;
- sportization, which allows to increase the efficiency of the above processes based on the use of the most powerful potential of sport.

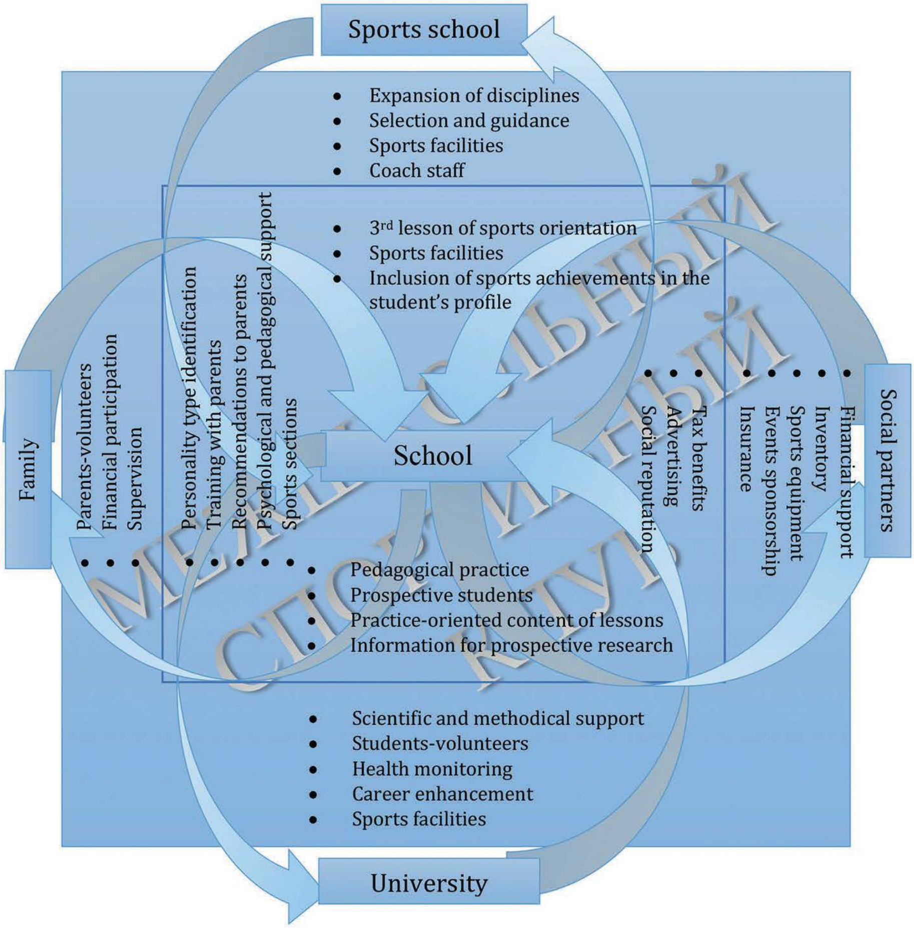

Figure 1. The subject and technological component of the system of sportized physical education

The technological (or procedural) aspect of the project of a system of sportized physical education is represented by:

- interschool sports club activities;
- sports sections operating in the schools participating in the interschool sports club activities;
- interaction with Children and Youth Sports School on the basis of partnership agreements;
- the author's modular program of the third lesson of physical education of a sports orientation;
- programs of preventive psychological support, psychological group training and individual self-training, programs aimed at increasing stress resistance, preventing the damaging effects of acute and chronic stress;

- pedagogical and propaganda activities aimed at the assimilation and implementation of the rules of a healthy lifestyle by each child and members of his/her family;
- pedagogical activities that ensure self-realization, a situation of success, a positive self-esteem, personal comfort for each child included in the educational process.

In terms of content, the formation of a fundamental educational product is ensured by:

- sportization of both lessons and extracurricular physical education of students (the third lesson of a sports orientation, motivating classes in sports sections, classes in sports sections);
- individualization of education and the compliance of the educational program to the physical, mental and socio-pedagogical competence of a child, his/her individual learning abilities;
- compliance with the requirements of sanitary documents in an educational institution under medical supervision;
- implementation of medical preventive programs at the state, regional and institutional levels;
- rational organization of nutrition and microsocium in an educational institution and in the family;
- formation of meta-subjective health-forming educational competencies of students;
- compulsory pedagogical interaction of the educational institution and the family in matters of health formation;
- promoting the formation of health and health-forming competencies of teachers;
- humanization of pedagogical activity;
- regular monitoring and subsequent consideration of objective indicators of all components of the health status of subjects of education.

INSTEAD OF CONCLUSION

The sports orientation of the lesson and extracurricular forms of physical education on the premises of Interschool Sports Clubs increases interest in classes, forms a strong positive attitude and sports motives, contributes to socialization and social integration. In modern studies, most scientists consider attitude as the phenomenon of broad personal education, the essence of which is combined by two functions of human consciousness: reflection of reality and subjective attitude to it. It follows that the education of the person obliges us to create a personal and semantic content in the educational space. The phenomenon of sport, in its modern sense, is most fully consistent with the solution of this problem: wrestling is full of emotional interpersonal and intergroup experiences, a variety of areas of self-realization, self-organization and socialization of a person, a variety of sports roles, an arena of "living" with a personality of various social roles. Achieving these goals is possible only when participating in various forms of club sports.

The educational potential of sports allows forming the positive traits of personality and character, as well as including physical education, sports and universal values in the child's personality. The meta-subject component of the health-forming activity completes the acquisition of a new quality system. It allows not to limit the educational component to teaching knowledge and skills but to form a complex of narrow, general and meta-subject competencies expected by society from the graduate. Thus, the experimental system of physical education ensures the interaction of its elements in forming students' health.

The relationship with the next structural element of the system is predetermined by the need for extensive regular monitoring of objective indicators of students' health and the lack of necessary equipment and qualified specialists at institutions. The implementation of such activities is facilitated by the inclusion of higher educational institutions that has the personnel, laboratory, instrumental, and scientific potential for carrying out such activities. The Institute of Sport, Tourism, and Service (SUSU) was included in the experimental system represented by scientists of various fields: physiologists, biochemists, physicians, psychologists. This allows objectively using modern diagnostic equipment to evaluate all health components: physical, somatic, mental and moral, that is, to evaluate the efficiency of the experimental pedagogical system.

The health-forming integration of educational disciplines is a system determining factor-chronotope of the health-forming educational space. It is focused on the health of students and implemented on the basis of the meta-subject approach by highlighting in each academic discipline a circle of real objects connected with "health" as a fundamental educational object.

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STUDY ON THE BMI STATUS OF SECONDARY SCHOOL CHILDREN IN THE SOUTH-EASTERN PART OF ROMANIA

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SUMMARY

The study is based on the body mass index of students between the ages of 10 and 14. The body mass index of 5043 students was tested in order to bring out the fact that the degree of obesity is not as high as health representatives claim. By means of this research we found that a percentage of 49% of the tested children were normal weight and only 2.31% were obese. The causes of obesity in these subjects may be metabolic disorders. The existence of obesity cannot be attributed only to eating habits, lack of physical activity or a sedentary lifestyle.

Key words: secondary school children, body mass index, obesity

INTRODUCTION

The age, weight and height are indicators that can be used to assess the nutrition and/or health status, both individually and collectively. The combination of these indicators can identify the category of children who had certain nutritional problems, as well as the type and duration of these problems.

The individual anthropometric characteristics of a child population are simple predictors of future health events reflected, most of the time, by obesity.

Obesity is a disease characterized by weight gain due to adipose tissue, gain which can be caused by some genetic, metabolic, cellular, psychological or social factors (Coşoveanu & Bulucea, 2011).

Studies have concluded that it is easier to prevent childhood obesity than to treat it. Parents allow their children to spend too much of their free time in front of televisions and computers, schools have a reduced number of classes allocated to physical activity, and many children are exempt from physical activity for medical reasons, which are more or less real. Walking is a rarity, schools have no sports facilities, and parents are sometimes too busy with daily worries.

Most international research shows that a large percentage of the school population has a tendency towards obesity or is obese. In Romania, too, such research highlights the tendency towards obesity within the school population due to physical inactivity and inadequate nutrition. That is why the present study aims at finding out whether the tested school population has this tendency towards being overweight and obese.

METHOD

Subjects

The research was conducted in the period 2018-2019 on a group of 5043 students in grades 5-8, aged 10-14 years, from rural and urban areas of Galați, Bacău and Vrancea counties. The distribution of students that participated in the research is presented in table 1.

Table 1. *The distribution of the students included in the research by grade, gender and age group*

Grade	Gender		Total
	Boys	Girls	
5th	918 (51.5%)	864 (48.4%)	1782 (35.3%)
6th	495 (46.7%)	564 (53.2%)	1059 (20.9%)
7th	540 (49.5%)	549 (50.4%)	1089 (21.5%)
8th	558 (50.1%)	555 (49.8%)	1113 (22%)
Total	2511 (49.7%)	2532 (50.2%)	5043 (100%)

Measure

The body mass index is used to determine the excess weight. It does not directly measure the adipose tissue in the body, but by interpreting the BMI we get information about body weight. The determination of the BMI is performed by using the following formula:

BMI = Weight (kg) / Height $(m)^2$

The classification of the resulted values in order to determine the nutrition status of the children was performed according to table 2.

Table 2. *Body mass index and nutrition status of children*

Definition IOTF - BMI (kg/m^2)
< 18 – underweight
18.5 – 24.99 – normal weight
25 – 29.99 -overweight
30 – 34.99 - obesity
>35 – morbid obesity

The body mass index was calculated using the EXCEL program.

Ethical considerations

The students participated voluntarily in the study after having received a detailed explanation of the objective and implications of the research. Written informed consent was provided by the parents as well as by the participants. The study was approved by the Research Ethics Committee of the “Dunărea de Jos” University, Faculty of Physical Education and Sport.

RESULTS AND DISCUSSION

Obesity represents a global problem, affecting a fairly high percentage of children on all continents. In the general context of the increasing global trend in the frequency of obesity, this topic has aroused more and more interest, representing the research topic of extensive studies.

The results of our study show that the majority of students in the investigated group, 49.61% (2502) are normal weight, 38.37% (1935) of them are underweight, 9.63% (486) are overweight, and a small percentage, 3.36% (120) is obese (Figure 1).

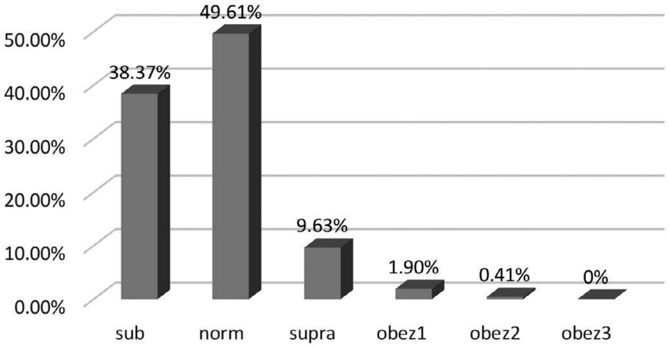

Figure 1. The percentage distribution of students in the investigated group according to their BMI

Underweight students, 49.50%, and normal weight ones, 41.24%, prevail in the age period 10-11 years, as compared to overweight children,7.57%, and obese ones, 1.69%. Thus, we can see that at this age, children are not overweight but malnourished (Figure 2).

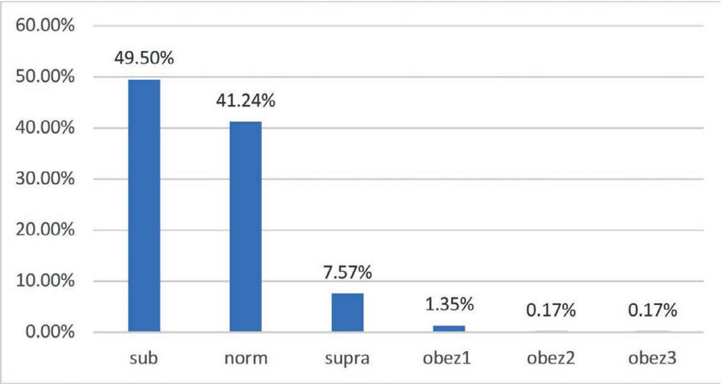

Figure 2. Percentage distribution of 5th grade students according to BMI

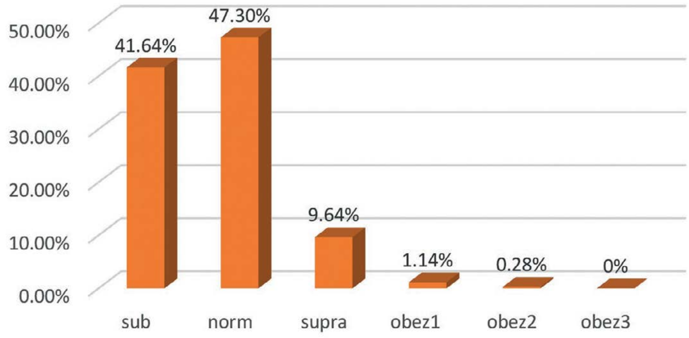

Figure 3. Percentage distribution of 6th grade students according to BMI

In the sixth grade there is a change in the predispositions regarding the body mass index. As a result, a percentage of 47.64% of the researched group were classified as underweight, 47.30% were normal weight, 9.64% overweight and 1.42 % obese (Figure 3). Moving to a higher age category, 11-12 years of age, we notice the tendency towards an increase in the percentage of overweight children as compared to those in the age group 10-11 years and a decrease in the percentage of obese children.

The subjects included in the research group, aged 11-12 years obtained the following results: 30.02% were underweight, this percentage decreasing as compared to the previous age ranges, 54.54% were normal weight, this percentage increasing as compared to the previous age ranges. On the other hand, the percentage of overweight children increased to 11.84% and that of obese children to 3.6% (Figure 4). We may notice a decrease in underweight subjects but also an increase in the overweight and obese ones.

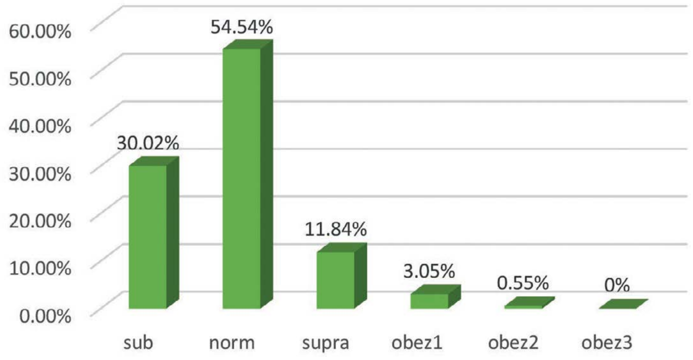

Figure 4. Percentage distribution of 7th grade students according to BMI

After analysing figure 5 we note that, at the age of 13-14, the percentage of underweight children decreases by 25.60%, the number of normal-weight students increases by 60.37%, the percentage of overweight pupils decreases slightly by 10.78% and of obese children by 2.5%.

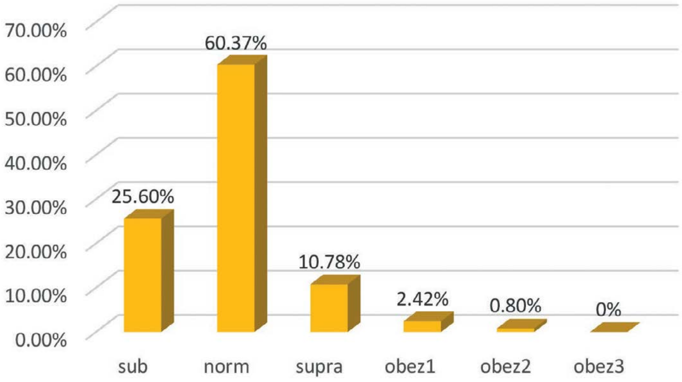

Figure 5. Percentage distribution of 8th-grade students according to BMI

Most of the students who participated in the study are normal weight, with a BMI between the WHO reference values 18.5 - 24.99, their body weight being the normal one for their age. Overweight children represent a small percentage, i.e. their body weight is lower than the normal one for their age.

A multitude of studies have shown an increase in the frequency of overweight and obese children and teenagers. There is also an increase in the risk factors that lead to heart diseases, such as being overweight, obesity, an unhealthy lifestyle, a sedentary lifestyle and unhealthy eating habits. Nevertheless, this is not true for the group of subjects from the south-eastern part of Romania that participated in the research.

In our country, in 2016, studies conducted by the Universities of Medicine in Timișoara, Bucharest, Iași, Târgu Mureș and data from the National Institute of Public Health showed that 19.7% of the girls and 29.2% of the boys were overweight and 5% of the girls and 10.7% of the boys were obese. On the other hand, 15.3% of the girls and 13.3% of the boys were underweight, and 2.8% of the girls and 2.8% of the boys were moderately and severely underweight. As compared to a study conducted in 2006, the percentage of obese boys has doubled in the last 10 years. During this period of economic growth for Romania, there was an unhealthy nutritional transition, with an increase in the consumption of foods with low nutrient content and high energy density (concentrated sweets, juices, fast food, chips), which led to weight gain in children and adults, with important consequences on health throughout life.

Research conducted in 2015 by Kulkarni et al., in India on a group of 4253 children aged 10-14 regarding the BMI, highlighted the following results: underweight children – 1379 (32.5%), normal weight children – 2822 (66.4%) and obese children - 52 (1 ,2%) (Kulkarni, Nagendra, Kumar, Siddalingappa, & Madhu, 2014).

A study conducted in Greece, in 2016, had the following results: 9.9% of the participants were classified as being normal weight, 23.9% were classified as being overweight and 6.3% as being obese. In particular, for boys and girls respectively, 69.1% and 70.4% had normal weight, 23% and 24.8% were overweight and 7.8% and 4.7% were obese (Michalopoulou et al., 2011).

Becerra et al., conducted research on 12–14 year - old children in Jaen, Spain. The results were as follows: Healthy - 199 (67.2%), Overweight 73 (24.7%), Obese 24 (8.1%). The results of this work show the existence of low self-esteem risk groups. Therefore, it is necessary to plan actions aimed towards reinforcing and increasing self-esteem. Girls and young adults with overweight and obesity problems should perhaps be a main focus of intervention, since these groups have a greater likelihood of demonstrating low self-esteem (Becerra, Muros, Cuadros, Sánchez, & González, 2015).

A study conducted in South Africa on 1,361 children (boys: n = 678; girls: n = 683), aged 9–13, showed the following results: underweight B 69%, F 82%, normal weight B 27, 7%, F 18.1%, overweight B 2.6%, F 1%, obese B 0.7 F 0.6% (Moselakgomo & Van Staden, 2019).

CONCLUSIONS

From the centralized data and their analysis, it can be seen that the weight of children aged 11-14 is mostly normal. A large percentage of the subjects (49%) falls into the category of normal-weight children. The percentage of the school population in the evaluated group that presents obesity is relatively low (11.94%), including the number of overweight children. The results of the study show that, by using the BMI, the percentage of obese people is not as high as health statistics say. The causes of obesity in these subjects may be metabolic disorders. The existence of obesity cannot be attributed only to eating habits, lack of physical activity or a sedentary lifestyle.

We believe that supporting children by means of organized physical activity programs could contribute to their harmonious physical development.

The changes that are observed from one age category to another can also be attributed to the hormonal changes specific to the post-puberty and puberty period, a period in which hormones exert specific effects on the adipose tissue and the muscle mass.

The subjects come from both rural and urban areas, where the standard of living is a different factor that can influence the harmonious growth and development of the body.

The study is a foundation for future research. The authors intend to carry out research through other methods to highlight the level of weight. There will also be research on the comparison between different ways of investigation for the possibility of reflecting this condition for school-age children.

The study is a foundation for future research. The authors also intend to carry out further research with the help of other methods in order to highlight the weight level. The authors also intend to carry out research on the comparison between different ways of investigation regarding the weight of school-age children.

Acknowledge: All authors have an equal contribution to the publication.

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APPLICATION OF TRAINING TECHNOLOGY PROGRAMS AND DOSED, PLANNED, PHYSICAL ACTIVITIES FOR CARDIOVASCULAR PATIENTS WITH IMPLANTED CORONARY STENTS

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SUMMARY

Training technology, as a method of choice in post-operative therapy of patients with implanted coronary stents, has given results, primarily due to the non-invasive nature of the therapy. Humans, as kinetically dependent beings, are familiar with the nature of movement Professional guidance and planned procedures use the nature of human motoric values in order to full recovery. The individual physiological characteristics of all patients are also crucial. Subjective analyzes contributed to the objective values of each patient. Hypokinetic syndrome was a common feature in all patients, which implies that as the main etiological factor of cardiovascular diseases, it must be the focus of attention in the therapeutic part of the treatment. Dosed exercises, professionally monitored, aim to initiate the physiological norms of the organism. By initiating physiological processes and encouraging the creation of an adequate oligo-structure, the organism, as a functional and complete unit, is given space for self-healing, to achieve the oligo-structure focuses on the location that is deficient in the human body. The cardio part of the therapeutic program is based on natural movement for these reasons. The movements that patients are exposed to, while working on a treadmill or static exercise machine, such as a bicycle, simulate natural, innate and non-invasive movement. In the aerobic part, which includes shaping exercises, continuous and dosed contraction of smaller muscle groups is stimulated. Their activation stimulates an oligo-structure that contributes to adequate systemic reperfusion. The individual sensations that patients feel in the very process of training technologies give room for the detection of secondary problems that are not related to the cardiovascular system. The observed problem with the cervical spine, endocrinological problems, as well as pathological phenomena in the locomotor system, contribute to the confirmation of the thesis that the organism must be treated as a whole structure. Functionally, in both of physiological and pathological processes, by opening the cardboard - physiological diary, precise anamnesis, adequate medical documentation and concise monitoring of the patient, an error in the assessment of physical status is prevented and a clear physiological picture of the patient's status is obtained. Pedagogically and psychologically acceptable approach, the therapist towards the patient contributes to the adequate assessment of all parameters included in the analysis and prevents the impact of anxiety in patients on the goal of therapy. Cardiovascular patients do not have basic medical knowledge, but are informed about the essential function of the heart muscle in existence. When all the parameters in the approach to the patient, work with the patient and thorough monitoring of the obtained data are respected, the therapeutic application of treatment technologies gives concrete results.

Key words: training technologies, cardiovascular patients, dosed exercises, hypokinetic syndrome, coronary stents

INTRODUCTION

Cardiovascular diseases are increasingly present, both in Serbia and in other parts of the world. According to the official report of the Ministry of Health of the Republic of Serbia - Dr. Milan Jovanović Batut, mortality caused by heart diseases is significant and the first in terms of mortality statistics, patients suffering from cardiovascular diseases. In Serbia, about 55,000 people die of heart diseases every year, which is the size of population of a small town. The main cause of diseases of the cardiovascular system is lifestyle, increased stress and low hygienic living conditions. In the last thirty years, the importance of prevention has been increasingly pointed out, for which we are obviously late, but prevention programs are proving necessary in immediate treatment. The recommendation of official institutions and the World Health Organization is that the promotion of healthy lifestyles must be persistent, persistent to the level of immediate adoption by a wider population. Bearing in mind the development of health problems and the necessity of the connection between science and the profession trough practice. Thirty-four years of work and therapeutic experience with training technology, resulted in the formation of a program that has the task and goal to adjust the dosed physical activity to all age categories and all health conditions with prevention, correction, therapy, revitalization, rehabilitation, recreation, sports recreation and professional sports. Since not every physical activity is always dedicated to health and can often cause damage, it is necessary to adhere to the rules of training technology. Physical activity must be dosed, planned, professionally guided and applicable. Any improvisation or lump sum assessment can cause a risk zone and a contra-indication zone. Certainly, in the therapy of cardiovascular patients with implanted stents, dosed and controlled physical activity is recommended. Dosed physical activity is also used in the prevention of potential complications. All patients are advised to exercise accurately and in moderation. In the deficit of knowledge and motor-adequate condition, patients often improvise, practicing an exercise that they remember, invent or uncritically copy. Improvised work gives improvised results, which is inadmissible and strictly ethically forbidden in working with such patients. The preventive moment of work with cardiovascular patients is based on the prevention of further potential complications. The therapy is based on stimulating the reperfusion of damaged parts of the cardiovascular system, while the diagnostic part of the procedure is reduced to the perception of secondary systemic disorders. Given that cardiovascular, endocrine, locomotor diseases are the result of neglect of a human as a whole functional unit, the focus of the profession must be focused on a human as a whole functional unit. Anxiety and fear are often noticed in communication with the mentioned type of patients, because lay information has its share in the psychological status. This parameter is considered, to when working with patients. A frightened patient cannot provide evaluative accurate data during the program. In this regard, a pedagogical approach is necessary. Also, in addition to the therapist's approach, there is also an adequate ambience, an exercise site, which must be prepared and hygienically adequate for use (exercise room).

MATERIAL AND METHODS

The sample of this research consisted group of subjects after cardiac surgery with implanted coronary stents, aged between 40 and 75 years. The heterogeneous structure of patients was involved with individuals of different social status, professional activities, gender, living environment, and personal good or bad habits. What was common to all patients in the heterogeneous group was an identical or similar cardiac diagnosis. The patient sample consisted of 41 subjects, while the initial number of respondents was over 50.

CARDIO-VASCULAR PATIENTES (CORONAR STENT)					
I.D.	GENDER	YEAR OF BIRTH	PROFESSION	INCLUDED	DISCLUDED
M.A.	Female	1940	Worker	YES	
S.P.	Male	1950	Pensioner	YES	
S.K.	Male	1952	Worker		YES
LJ. K.	Male	1949	Pensioner	YES	
M.N.	Male	1951	Worker	YES	
Ž.B.	Male	1949	Lawyer		YES
LJ.Ž.	Female	1950	Professor	YES	
B.A.	Female	x	Medical Worker	YES	

In accordance with this data, the number of patients who gave up participating in the program process was also a reference. The reasons for withdrawing from the program were different. Most often, giving up was explained as saturation from the clinical, exhaustive environment of practice and trust in alternative methods of post-operative therapy. The analysis includes already existing diagnoses, initial and control examination by a specialist doctor. Patients submitted photocopies of medical findings that were a part of the cardboard - physiological diary. The process of working with patients consisted of the following phases: opening a medical record, noting down patient's medical history, program proposal, survey of patient's previous knowledge on the subject, initial measurements at the training technology center (body weight, body height), initial measurements that the patient records at home (pulse, blood pressure, body weight over a period of 7 days), initial tests (3), adaptation to training procedure (10 sessions), adaptation to training procedure (21 sessions) and the analysis of achieved results.

Medical recording documentation
-Physiological diary-card-

In this part of the program we get to know the patient better. Through conversation we come to subjective and objective data about the patient, and the data is recorded. In order to thoroughly process the clinical picture and therapy of all patients, physiological diaries-cards were opened, with all relevant data.

Medical history

The patient submits all medical documentation. Through conversation, he or she describes his subjective difficulties and the time when they happened. He or she describes the problems, orally and subjectively. He or she reports the presence of allergies, previously prescribed medications, medical data that are not related to the current diagnosis, as well as bad habits (smoking, alcohol consumption, diet).

ЦЕНТАР ЗА ПРОЦЕНУ ФИЗИЧКОГ СТАТУСА И ТРЕНАЖНЕ ТЕХНОЛОГИЈЕ
Проф. др Веско Драшковић

ПРЕЗИМЕ И ИМЕ ____________ ДАТУМ ПОЧЕТКА ______

АДРЕСА И ТЕЛЕФОН: ____________

БР. ______

АНАМНЕЗА:

Генерална анамнеза:

Главне тегобе:

Медикаменти:

Алергије:

Консултантски преглед:

ДР. СТОМ. МАЛИН ДРАШКОВИЋ ____________

ПРОФ. ДР ВЕСКО ДРАШКОВИЋ ____________

Initial measurements taken by the patient at home

The aim of this part of the test is to assess the level of stress to which the patient is exposed during 24 hours, which is seen by oscillations in pulse and blood pressure, as well as stomach volume, followed by oscillations in morning and evening body weight. By measuring these parameters at home, in the morning and in the evening, in an environment that is not psychologically invasive, the results can be compared with those during the application of training technologies.

ЦЕНТАР ЗА ПРОЦЕНУ ФИЗИЧКОГ СТАТУСА И
ТРЕНАЖНЕ ТЕХНОЛОГИЈЕ
Проф. др Веско Драшковић

Презиме и име ____________________ **Датум почетка** ______________

Број картона ________________

Датум	ПУЛС(ХР)		Т.МАСА(ТМ)		К.ПРИТИСАК(ТА)	
	Јутро	Вече	Јутро	Вече	Јутро	Вече

Напомена:

Пулс, телесну масу и притисак мерити ујутро при буђењу и увече пре спавања.
Мерење вршити палпаторном методом или електронским мерачем. Палпаторном методом мерити на врату или на ручном зглобу. Мерити на 30 секунди и добијену вредност помножити са два. Вредности пулса мере се на 60 секунди.

- Добијени резултати мерења пулса и притиска се користе код процене кардиоваскуларног система у миру, који указује на степен замора, стреса и одређују полазну основу у зони оптерећења.
- Добијени резултати телесне масе показују дневни волумен (дневно уношења хране), као и одређивање БМИ (боди мас индекса).

Program proposal

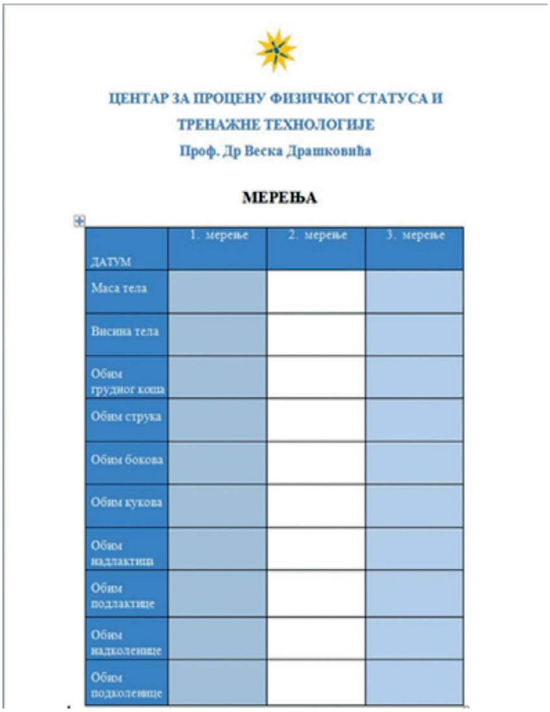
Working with cardiovascular patients with implanted stents, caution is of a crucial importance. A simulation of natural motion is proposed which must be continuous and accurate. Therefore, exercise machines that simulate natural movement (treadmill and stationary bicycle) and aerobic exercises in accordance with the patient's motor abilities are proposed. Patients directed to the training technology center were thoroughly treated. A recognition of patient's comprehensive and thorough medical history was crucial, as all cardiovascular patients already had or have a secondary diagnosis. In cooperation with the competent clinics and attending physicians, individual programs have been created.

Information survey

The survey provides valid information about how well the patient actually understands the entire exercise process - what does he or she think about it and how much does he or she know. This part of the opening of the physiological diary-card, gives the therapist the necessary information about the previous physical status of the patient. The goal is to acquire the objective information precisely and adapting the individual program to them. Essentially, written patient survey contributes to objectivity of the application of the professional methods.

Initial measurements

The patient reports his or hers weight and height, since the last subjective measurement of body weight and height. The obtained data are compared with the measurements that are practiced at the first entry into the gym and diagnostics. Initial measurements are based on body weight, body height, chest circumference, waist circumference, forearm circumference, upper arm circumference, lower leg circumference, and upper leg circumference. Essentially, the current morphology of the body is analyzed in relation to the reported one. Patients were informed about the necessary equipment for the analysis process. Therapists insisted on clean gym shoes, shoes and a clean towel. The upper part of the tracksuit was supposed to be long-sleeved for the purpose of personal hygiene and maintaining thermoregulation. Thermoregulation had been explained to patients as the prevention of potential colds and the preservation of body heat. Appointments for working with patients were organized in such a way that the absolute attention of the therapist was directed to the patient, so that three appointments were scheduled per appointment. The time required for adequate testing was about 45 minutes to an hour. In accordance with these criteria, patients scheduled their appointments.



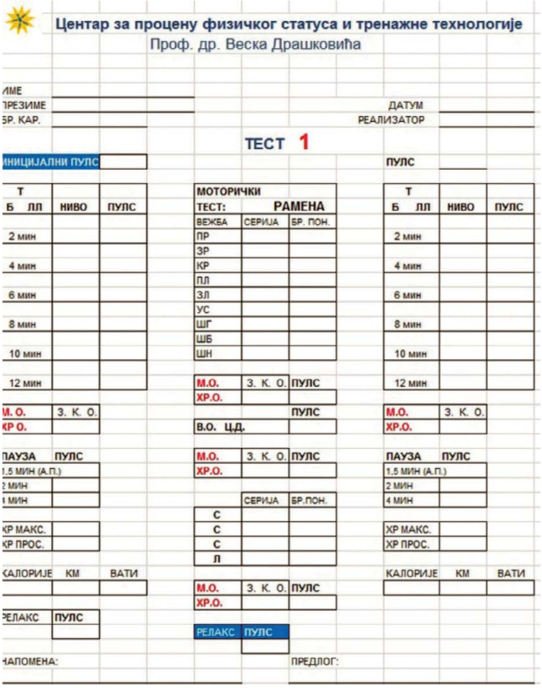
ЦЕНТАР ЗА ПРОЦЕНУ ФИЗИЧКОГ СТАТУСА И
ТРЕНАЖНЕ ТЕХНОЛОГИЈЕ
Проф. Др Веска Драшковића

МЕРЕЊА

ДАТУМ	1. мерење	2. мерење	3. мерење
Маса тела			
Висина тела			
Обим грудног коша			
Обим струка			
Обим бокова			
Обим кукова			
Обим надлактица			
Обим подлактице			
Обим надколенице			
Обим подколенице			

Initial tests

First initial test consisted of treadmill or static bicycle. Upon the arrival at the first initial test, the patient is introduced to the plan and program throughout conversation. He reports his subjective feeling and mood. By completing a survey based on general information about training technologies, healthy habits, bad habits and routines, he orally submits the information that the therapist should be familiar with during the implementation of the program. The patient's initial resting heart rate is measured. It is referred to the plan and program of the scheduled test.



Центар за процену физичког статуса и тренажне технологије
Проф. др. Веска Драшковића

ИМЕ
ПРЕЗИМЕ
БР. КАР.

ДАТУМ
РЕАЛИЗАТОР

ТЕСТ 1

ИНИЦИЈАЛНИ ПУЛС

ПУЛС

Т Б ЛЛ	НИВО	ПУЛС
2 мин		
4 мин		
6 мин		
8 мин		
10 мин		
12 мин		

М. О.	З. К. О.
ХР О.	

ПАУЗА	ПУЛС
1,5 МИН (А.П.)	
2 МИН	
4 МИН	

ХР МАКС.	
ХР ПРОС.	

КАЛОРИЈЕ	КМ	ВАТИ

РЕЛАКС	ПУЛС

НАПОМЕНА:

МОТОРИЧКИ ТЕСТ: РАМЕНА

ВЕЖБА	СЕРИЈА	БР. ПОН.
ПР		
ЗР		
КР		
ПЛ		
ЗЛ		
УС		
ШГ		
ШБ		
ШН		

М.О.	З. К. О.	ПУЛС
ХР.О.		

	ПУЛС
В.О. Ц.Д.	

М.О.	З. К. О.	ПУЛС
ХР.О.		

	СЕРИЈА	БР.ПОН.
С		
С		
С		
Л		

М.О.	З. К. О.	ПУЛС
ХР.О.		

РЕЛАКС	ПУЛС

ПРЕДЛОГ:

Т Б ЛЛ	НИВО	ПУЛС
2 мин		
4 мин		
6 мин		
8 мин		
10 мин		
12 мин		

М.О.	З. К. О.
ХР.О.	

ПАУЗА	ПУЛС
1,5 МИН (А.П.)	
2 МИН	
4 МИН	

ХР МАКС.	
ХР ПРОС.	

КАЛОРИЈЕ	КМ	ВАТИ

The test consists of a cardio and aerobic part. The cardio part of the test uses training machines that simulate natural, non-invasive movement. Treadmills and static bicycles are the training machines of choice in this segment of the test. In the first part of the test, the patient goes through a 12-minute sequence on a treadmill, measuring the pulse every 2 minutes. It is important to point out that the patient should be gradually and accurately introduced to work on the treadmill and bicycles in order to prevent potential injuries and adapt to the proposed motoric task. Also, the subjective feeling of side effects (discomfort, insecurity, dizziness, unusual movement of the surface) is monitored during the entire period of 12 minutes and affects testing and monitoring. In the testing process and exercise programs, we also considered as a significant factor the subjective feeling during the effort, especially in the period of adjustment to the effort, where the motoric and functional value must be adjusted and adopted by patients.

The second part of the initial test consists of shaping exercises, natural movements that encourage adequate redistribution of the oligo-structure acquired during the first cardio test. Shaping exercises are based on natural movement, manual dexterity and motoric compatibility. Through shaping exercises, subjective sensations are also analyzed, which patients mostly express in the form of pain, muscle tension, and a subjective feeling of weakness. Since the exercises themselves are based on natural movement of moderate intensity, it is often concluded that this is an adequate demonstration to the patient, and even to the therapist, about the evident physiological neglect of the whole organism. It should not be forgotten that the dosed load on the muscles is a real indicator of the condition that the patient should be aware of, which also gives the therapist the information, what information he has at his disposal in the further process. After the second part of the initial testing, the pulse is measured. Pulse is measured after exertion and during the period of active rest.

The third part of the initial test is based on repeated cardio testing. With the repeated test, the patient, already familiar with the training machine, was introduced to the process training survey. He or she feels relaxed working on a training machine that is close to him or her through his or hers already motorized natural movement. Pulse is measured every two minutes for a period of 12 minutes. Subjective feeling should not be neglected because the main determinant for status assessment is the moment of functional and motoric failure. The psychological moment of satiety and boredom in this part of testing should not be neglected either. By stimulating the endocrine system in the process of reactivation of the whole organism, patients can compensate for their confusion, with what their physiological accuracy is, by quarrelsome behavior and rhetoric. The speed and load on the training machine are slowly decreasing.

The goal of a non-invasive end to training is to introduce the patient to a relaxing-passive rest. After passive rest-relaxation, oligo-structurally, the patient is inspired by the situation, communicative, physiologically awakened and as such has the first non-professional insight into his physiological state. Functional and motor failure at the end of the third part of the initial test are the clearest demonstrations of physical status. Passive rest-relaxation means reperfusion of the whole organism, bringing the body into the position of the physiological horizontal of the spinal column and stimulating the necessary oligo-structure for complete recovery of the organism. Large muscle groups relax and ventilation and respiration stabilizes. By measuring the pulse at the end of the relaxation and comparing it with the pulse at the beginning of the test, the fatigue of the heart structure after physiological effort is determined numerically.

After completing the first test, the patient is assigned the next date for the continuation of the program, the second initial test (treadmill or static bicycle). In the second session, the patient is partially acquainted with the methodology of work. He has his observations and conclusions, which he explains to the therapist. It is targeted that in agreement with the patient, the interval between the first and second initial test should not be longer than 72 hours.

Principles of testing

1. Treadmill

The treadmill simulates a natural movement that the patient is already familiar with. The dosed speed of the machine is adapted to cardiovascular patients. The speed at which the patients, during testing, move on the lane is in the range of 2.0, 2.5, 3.0 to 3.5 km/h, depending on the realistic capabilities of the patient. It is important to emphasize that oscillations from 2.0 to 3.5 km/h are not contra-indicated but are objectively exposed to the assessment of the patient's capabilities.

2. Static bicycle

Levels indicated on a bicycle, depended on the manufacturer of the training machine, range from the basic first level, to the third. The continuity of revolutions should be maintained in the interval from 65 to 70 rpm (revolutions per minute).

3. Shaping exercises

Number of muscle contractions in this segment is over 4000. Contractions were concentrated in the therapeutic order. Small muscle groups that are inactive during daily division are targeted. Number of exercises, proportional to the possibilities, which determines the moment of motoric failure.

Adaptation to effort

After the first initial tests, the patient is in the comfort zone. He or she is familiar with the training machines and the exercise program. In this therapeutic part, the patient adapts to his motor and functional capabilities. He practices his own, natural, movements and adapts them to him- or herself. By maintaining the physiological determinant of the organism, recovery occurs, the same as a whole. After completing the program, patients are referred again for consultation with the attending physician at the cardiovascular clinic. The measure of results, the application of training technology programs is depicted by the improvement of the general condition of the patient, as well as the accelerated dilation of blood vessels. Also, in the process of tests, dysfunction of other systems in the body was diagnostically noticed. Locomotor and endocrine system.

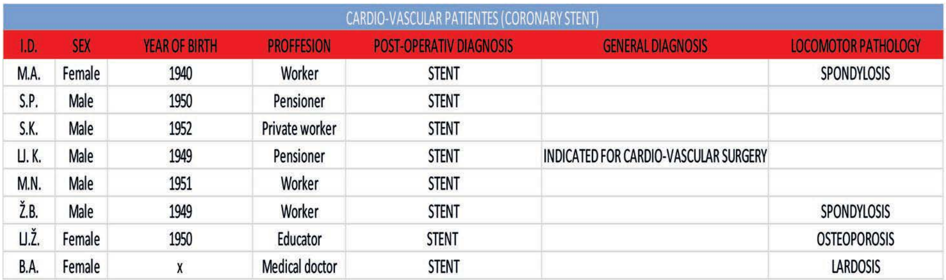
Results of medical benefit

Objective values. Measurement parameters: Having in mind the heterogeneous structure of patients based on age, sex, social status, profession and causes that led to this condition, healthy and bad habits, we used medical documentation for the application of dosed load in the constant presence of a competent doctor, as a consultation. And checking the results achieved. Since these are heart patients who need to improve their physical status and functional values in the body, we used standard tests and methods.

We also measured the complete capabilities of the organism and the mobility of the bone and joint system.

Results of the secondary analysis - 100% problem with the cervical spine in the diagnostic procedure for assessing physical status, we came to significant data that in 100% of cardiovascular patients, there is also a problem with the spine, especially on the cervical spine - kyphotic condition And spondylotic changes in the spine. Since this is important in our training technology, with this method we have achieved that through the program of revitalization of the cardiovascular system we also do the therapeutic part for cervical spondylosis, which is absolutely compatible and without the presence of contraindications.

In 80% of patients we noticed metabolic problems, so in order to solve the problem more completely, we consulted the Department of Metabolic Diseases with Dr. Prof. Vesna Dimitrijević Srećković, who confirms our observation and gives a complete proposal for raising the quality of life through diet (Mediterranean diet), regular endocrinological examinations and consultations, as well as the introduction of new lifestyles. - Complete control of cardiologists During the application of training technology, we had the support and complete logistics of the Institute for Cardiovascular Diseases of Dedinje and the competent doctor, cardiologist for this group of patients Dr. Milijana Balević.



CARDIO-VASCULAR PATIENTES (CORONARY STENT)

I.D.	SEX	YEAR OF BIRTH	PROFFESION	POST-OPERATIV DIAGNOSIS	GENERAL DIAGNOSIS	LOCOMOTOR PATHOLOGY
M.A.	Female	1940	Worker	STENT		SPONDYLOSIS
S.P.	Male	1950	Pensioner	STENT		
S.K.	Male	1952	Private worker	STENT		
LJ. K.	Male	1949	Pensioner	STENT	INDICATED FOR CARDIO-VASCULAR SURGERY	
M.N.	Male	1951	Worker	STENT		
Ž.B.	Male	1949	Worker	STENT		SPONDYLOSIS
LJ.Ž.	Female	1950	Educator	STENT		OSTEOPOROSIS
B.A.	Female	x	Medical doctor	STENT		LARDOSIS

DISCUSSION

This is a group of patients which is very sensitive to physical exertion and where physical exertion often causes cardiovascular complications. In order not to get into the risk and harmfulness of exercise, it is necessary to diagnose the existing realistic condition and the process of motor reeducation and accustoming the patient to the newly created situation. Memories of exercise are extremely strong, powerful and often a problem, especially when there is a subjective assessment of the patient and inspiration for movement. It further complicates the procedure of revitalization of stress, the impact of stress, life habits where stress is present, which is also provided by training technology in the chapter on the importance of exercising in an anti-stress program. It has been proven in our scientific research that motoric skills and functions in the body occur gradually, that in the beginning there is no significant statistical difference, but at a longer distance, a statistically significant result appears, which indicates more complex characteristics. It is that the patient has changed the way, lifestyle, habits and is in the zone of accepting a healthy life as a need, not an obligation which is the goal. In the assumptions of possible errors in working with such patients, we suggest gradualness, consistency and the exclusive load provided by the training technology.

CONCLUSION

Dosed, precise and objectively monitored exercise gives results in both prevention and post-operative rehabilitation of risk target groups. *Restitutio ad integrum* (full recovery) is a possible goal, only with the absolute cooperation of patients, prescribers, therapists and consultants. The correspondence of all the mentioned participants in the process of therapy is important, but the cooperation of the patient stands out as crucial. The methodology would give results through models only if it encounters an adequate response of patients in the form of will, desire and desire. Patients who participated in the project were factors of pathologically homogeneous group, heterogeneous natural status (sex, age, occupation).

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Theme 3

Approaches and Models for Children with Disabilities and their Parents

SUPPORT FOR PARENTS OF CHILDREN WITH NEURODEVELOPMENTAL DISORDERS[a]

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SUMMARY

Parents of children with neurodevelopmental disorders often lack support for raising their child. Problems that they face are numerous and include emotional, social, phycological and financial difficulties and limitations. The aim of the paper is focused on presenting available and relevant researches that consider various problems faced by parents of children with neurodevelopmental disorders (autism spectrum disorder and intellectual disability), as well as the types of support intended for them. Some types of support are: spousal support, support from relatives and friends, financial support, support from various services, social support, online social support and the like. In the paper, it is pointed out to specific problems that occur to parents of children with autism spectrum disorder and children with intellectual disabilities. Specificities for mentioned types of support for parents of these two groups were discussed.

Key words: support, parents, autism spectrum disorder, intellectual disability, problems

INTRODUCTION

The birth of a child with developmental disabilities brings many difficulties, primarily for parents. They go through different stages of coping with the reality they find themselves in, in order to be able to accept the situation in the best possible way and help their child develop maximum potential. Along that path they encounter various emotional, social, psychological and financial difficulties and limitations. Raising a child with disabilities affects the overall quality of life of the family and all its members. The source of possible difficulties in lives of these parents refers to a lack of support. Families with children with neurodevelopmental disorders (ND) face many challenges that affect different aspects of their lives (Davis & Gavidia-Payne, 2009).

Dimitrijević accentuates research findings that point to the problem families with a child with ND face. The predominant problems are difficulties in accepting the disorder, parental unemployment, chronic stress and fatigue due to continuous care for the child, reduced parental leisure opportunities, as well as worry and fear regarding the child's future (Dimitrijević, 2013). Milačić-Vidojević concludes in his research that one of the possible sources of problems for parents is the lack of support services (Milačić-Vidojević, 2008).

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Some of the problems that parents also encounter are: insufficient awareness of the facilities and services available and how to reach them, understanding of the roles of different professional staff profiles, problems originating from experts in understanding the situation of family and parents, and understanding their needs (Slopper, Greco, Beecham, & Webb, 2005).

In literature, other factors that influence the level of family difficulties of parents are cited and include the child's irregular sleep, behavioral problems, financial status of the family, employment of parents, lack of social support, failure to meet the needs of parents and the child by various services and parents stress coping strategies. The authors point to a high rate of poverty in families with a child with ND in the UK, up to 55%. These families have financial problems due to the fact that one of the parents, most often the mother, is unemployed due to the care of the child (Sloper & Beresford, 2006).

According to the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, 5th ed.) effective from 2013, the ND group includes:

- intellectual development disorder/intellectual disability (ID) (mild, moderate, severe and profound),
- communication disorders (language disorder, speech disorder, childhood fluency disorder, pragmatic communication disorder, unspecified communication disorder),
- autism spectrum disorder (ASD),
- attention deficit hyperactivity disorder (ADHD),
- specific learning disorders (reading disorder, writing disorder, calculation disorder, i.e. math related disorder),
- motor disorders (developmental coordination disorder, stereotyped movement disorder, tics) and
- other neurodevelopmental disorders (other specified neurodevelopmental disorder and unspecified neurodevelopmental disorder) (American Psychiatric Association, 2013).

Neurodevelopmental disorders include significant intellectual, motor, language, and social disabilities that arise during the developmental period. They are most often manifested and detected in early development before the child goes to school (American Psychiatric Association, 2013). Complexity in deficits ranges from very specific learning disabilities (such as spelling difficulties in which consonants and vowels are replaced during writing) to overarching difficulties in social or intellectual ability. These disorders often occur in comorbidity (i.e. people with ASD often also have ID). The importance of comorbid conditions is that they can determine the further course of treatment, the frequency and intensity of complications, type of education, as well as academic and health outcomes (Polyak, Kubina, & Girirajan, 2015).

In order to identify and overcome the problems that families face, it is necessary to understand the importance of the role of the family in the child's development and to understand the impact of the environment on family functioning. The foregoing refers primarily to professional and social support (Davis & Gavidia-Payne, 2009). Social support is multidimensional support that includes not only parents but also the wider family, friends and various types of services. White and Hastings indicate that it is important to recognize the significance of the role of social support on family functioning. This implies the need to improve the availability of support networks and identify the key types of support that the family needs. Most research focuses on broader family functioning, not social support itself (White & Hastings, 2004). Mitchell points out that members of the wider family (grandparents) can be a significant source of support, which can help improve family functioning. They can also be an additional source of stress, primarily due to the fact that they will go through the stages of adjusting to difficulties of a child's ND, same as child's parents. A misunderstanding of the child's difficulties and needs may also occur, which affects the quality of support they will provide. This can further lead to disagreements within the wider family, which then only contribute to stress for parents and poor family functioning. Despite these allegations, the study shows that members of the wider family (grandparents) are an important source of support, both financially and emotionally (Mitchell, 2006).

Researches are rarely focused on assessing the availability of different types of support. Small number of studies address the assessment of interaction between support provided and the positive outcomes of parents and the whole family, but the data available suggest that there is a connection (White & Hastings, 2004). This paper will attempt to fuse some of the findings regarding the problems of parents of children with ASD and ID and the support available to them.

The aim of the paper

The aim of the paper is to present available and relevant research that takes into the account various problems faced by parents of children with ND (ASD and ID), as well as the types of support they may receive.

METHOD

An overview of the relevant literature was made through a review of the electronic databases available through the Consortium of Libraries of Serbia for Unified Acquisition (KOBSON) as well as Google Scholar Advanced Search. Searches were made through the following search engines: ScienceDirect, Ebscohost, SpringerLink and WileyInterScience. The following keywords were used in the search: ID, ASD, parents, support, need for support, types of support, family support, family strengths, family activities and family assistance. Papers were collected and analyzed, in which the problems encountered by parents of children with ND are discussed, as well as papers describing possible support.

Review of the research

Basic parental problems and possible forms of support

Functioning, quality of life, expectations and outcomes in families with a child with ND depend not only on the severity of the disability, the child's characteristics and needs, but also on the characteristics of the whole family, the experiences of family members and the resources available to them (Thomas & Dykes, 2013). The prevailing belief is that families with a child with ND need different support across a number of areas (Oluremi, 2015).

Parents of children with ND more often socially isolate themselves than parents of children of the typical population (Oluremi, 2015). Domestic research indicates that parents feel they have no time for anything but a child with ND. Their child requires all-day supervision and care, and they do not have much time left for their careers, non-child care responsibilities, rest, socializing, relaxation and personal interests. Parents also find that they do not devote sufficient time to their other children (Žegarac, Džamonja-Ignjatović, Milanović, 2013).

One study shows that the level of stress in a parent of a child with ND is associated with the **level of support a parent receives from their partner** and the level of satisfaction with the marital relationship (White & Hastings, 2004). It has been noted that parents of children with ND have more marital problems than parents of children of the typical population. Some findings indicate that there is a high incidence of marital disputes and divorce among parents of children with Down Syndrome (Aldosari & Pufpaff, 2014). Mihić and his associates also talk about broken partnerships between spouses who have children with ND (Mihić, Rajić, Krstić, Divljan, Lukić, 2016).

Informal support is very important for parents, i.e. the support they receive from their relatives and friends, and most of all the support from their parents. Research shows that parents of children with ND, especially mothers, express greater satisfaction and lower levels of stress when receiving informal support from their relatives and friends and when interacting with them regularly (Aldosari & Pufpaff, 2014). This type of support has proven to be an excellent stress regulator in parents of these children (Kwai-sang Yau & Li-Tsang, 1999). In certain families, grandparents are the ones who take upon themselves the care of a child with ND for various reasons (so that the child's parents can work, if the child's parents have passed away, or have health problems, or they have lost parental rights due to neglecting the child). Research shows that, most often, grandmother takes the role of child caregiver, their age being 50 to 60 years old (Neely-Barnes & Dia, 2008).

Parents of this population often have financial problems. Payment for medication, special equipment, therapists, transportation, etc. is required for a child with ND, and parents often need **financial support**. For these reasons, parents are often forced to change their diet and reduce their spending on recreation, rest, relaxation and clothing. Numerous studies point out that fathers are the ones who stay in their jobs, continue to build careers, or are often focused on finding better paying jobs. On the other hand, mothers most often lose their jobs, or do not search for work, so that they can look after the child (Oluremi, 2015). Research in our country indicates that only 9.8% of families with a child with ND have both parents employed (Dimitrijević, 2013). Comparative studies show that mothers of children with ND, compared to mothers of children of the typical population, work fewer hours and are paid less for their jobs (Neely-Barnes & Dia, 2008). Research results show that parents who do not have financial difficulties exhibit higher levels of satisfaction with their lives and their parenting role (Davis & Gavidia-Payne, 2009). Research in our country shows that the most common sources of income in families with children with ND are state aid for help and care of another person (58.2%) and state financial aid for a child (42.5%). Less than half of families (42.2%) have salaries (Žegarac et al., 2013). Research shows that if the family has no financial problems, family relationships, interaction with the child with ND, and marital relationships are good, of good quality and with little or no difficulty (Meral & Cavcaytar, 2012). When assessing the quality of life of families with a child with ND, assessment of family income could be considered to identify the appropriate type of support that the family needs (Davis & Gavidia-Payne, 2009).

One source of problems for parents is dissatisfaction, or misunderstanding of their needs by **various support services** (Jones & Passey, 2004). Research shows that parents think that they do not receive satisfactory support from the educational and healthcare institutions that are helping them to care for their children. The most common indicator of poor quality of cooperation with these institutions is the rare involvement of parents in decision-making regarding the child and the parents feeling that the overall family functioning is not taken into consideration. Research shows that professionals often perceive parents as too demanding, overprotective, overwhelmed by feelings (Mihić et al., 2016), while parents often feel only as passive participants in decision making which concerns their child (Thomas & Dykes, 2013). Sources of difficulty for parents are aspects of the services they receive, such as the length of a particular program, the location of the service, or the venue of the program, as well as the frequency of contact with professionals (Davis & Gavidia-Payne, 2009). The services provided to the families of children with ND in our country are being carried out within the framework of social protection programs and most often represent an instrumental type of support (nutrition, therapy, care, etc.), they are not of a lasting nature and are usually available only to parents in major cities (Mihić et al., 2016).

Parents often experience trauma and stress due to a lack of information about the disorders that have been diagnosed, what to do next and to which institutions and services should they addressed to, so they could best meet their child's needs. Due to lack of information, parents often resort to alternative treatments, causing them to spend more money and sometimes those treatments even harm the health of the child. It is considered necessary to create more quality intervention programs for children with ND and their families. Primarily, there is a need for different forms of counseling, family education, skills training and different social services (Oluremi, 2015).

The support that parents often need most is help with **babysitting**. This kind of support allows parents to have time for themselves, relaxation and fun. There are childcare services in Ireland and the UK, which are regulated and intended for families with children with ND. In the United States, there are also services designed exclusively for children with developmental disabilities and children with chronic illnesses (Sung & Park, 2012).

Parents should be involved in an early intervention program so they can, with the help of a specialist, identify the services that can provide the type of support that best meets the child's needs at that moment (Jacob, Olisaemenka, & Edozie, 2015).

Early intervention programs in our country are still not being implemented satisfactorily. Parents find that they are not sufficiently involved and informed in one of the most critical times for their child and their entire family. They also think that education about the disorder that has been diagnosed, as well as information about the implications of the diagnosis on the child's development and the functioning of the whole family, should be organized. They also state that it is necessary to provide them with psychological support in dealing with conflicts, stressful situations and difficulties they encounter (Mihić et al., 2016). The same research done in our country indicates that few parents use any form of support directly addressed to them. The most common difficulties are inadequate time of conducting a program, lack of free time due to constant child care and lack of information about the existence of support programs (Mihić et al., 2016). Parents in our country believe that greater support from all levels of government is needed in order to improve the network of different services in our country (Žegarac et al., 2013).

Problems and support to parents of children with ASD

Parents of children with ASD face difficult challenges to cope with the grief they feel, concerns about the future, and difficulties of finding the appropriate support services their child needs (Anderson & Smith, 2014). One of the most significant periods in the lives of families with children with ASD is the diagnosis. Parents of children with ASD experience the whole process of diagnosis as stressful (Kalash & Olson, 2012). It takes a long time to get a diagnosis. Procedures from the detection of early ASD symptoms to diagnosis are different between countries, but in most states, families wait at least one year until the end of this segment (Mereoiu, Bland, Dobbins, & Niemeyer, 2015). Some authors think that the first reaction of parents, when a child is diagnosed, is to seek information about what is that specific disorder that has been diagnosed, what the implications and prognosis are, and practical advices (Murphy & Tierney, 2005). Parents often wonder what the reason for their child's diagnosis of ASD is, and whether they have contributed in any way to the development of the disorder, so they feel guilty about it. Also, some of them want to master the facts about this disorder so that they can help their child (Anderson & Smith, 2014). On the other hand, one of the sources of frustration is the lack of information coming from different institutions and services (Murphy & Tierney, 2005).

Numerous difficulties found in a child, such as challenging behavior that is often present in children with ASD, eating problems, sleep problems, or tantrums, affect the daily life of the entire family, relationships among members, and lead to chronic fatigue (Anderson & Smith, 2014). Parents express concerns regarding their child behavior when they are visiting someone, since destroying the furniture, objects and unacceptable behavior can occur, and for that reason visiting is avoided. One study found that the severity of ASD symptomatology positively correlates with the level of stress in parents, that is, more severe symptoms lead to higher levels of stress and greater dissatisfaction (Brown, 2014).

The diagnosis is followed by one of the most important periods in the life of a child with ASD during which the basis for further development is laid. It is a period of early intervention. Early treatment and family involvement in this system are very important for any child with ASD. Some parents are satisfied with this program, they feel that they are sufficiently involved in decision making, that support services are flexible, that they are adequately supported and that they have access to various resources. They state that they are satisfied with the established social support network that allows them to interact with other parents of children with ASD and to learn different intervention strategies to improve the child's communication and social skills and play. There are those parents who are not satisfied with this type of program. Their dissatisfaction most often relates to the cost of services and the time they have to wait to receive a particular service (Coogle, Guerette & Hanline, 2013). Many parents of children with ASD, despite the importance of early treatment, do not have enough time, energy, or resources to participate in it (Mereoiu et al., 2015).

Experts play a very important role in the lives of families with children with ASD. They should provide families with emotional support, encouragement, information support, identify the child's needs and how to meet them (Mereoiu et al., 2015; Shu, 2009).

Sometimes the source of frustration for the parents are the experts themselves. Parents object to the emergence of differences of opinion among professionals regarding adequate treatment. Different providers are sometimes perceived as not organized, not flexible, not responsible and lacking in knowledge to meet the child's needs, as well as not providing sufficient information, support and understanding to families (Shu, 2009). Parents conclude how the experts do not take into account their worries, doubts and suggestion (Mereoiu et al., 2015).

Parents of children with ASD experience more stress than parents of children with other ND (Dunn, Burbine, Bowers, & Tantleff-Dunn, 2001). There is evidence that parents of children with ASD experience the most stress compared to parents of children with ID and parents of children with chronic illness (Anderson & Smith, 2014). Some of these problems are related to increased negative health outcomes, marital dissatisfaction, disputes and conflicts, as well as anxiety (Dunn et al., 2001; Rivard, Terroux, Parent-Boursier, & Mercier, 2014). Mothers of adolescents with ASD report that they face more problems as parents and as a family, compared to mothers of adolescents with ID (Dunn et al., 2001). Research shows that the level of stress that occurs in parents of children with ASD is associated with the level of the child's social skills, behavioral problems, and worsening of the clinical picture (Wang & West, 2016).

These parents are at greater risk for marital issues and divorce, problems in relationships with other people and social isolation, than parents of the typical population (Dunn et al., 2001). Most often, mothers quit their jobs and quit their careers. Gray interviewed 32 families who had a child with ASD and came up with information that the mothers had plans to find a job at some point, or to return to their jobs that they left, but most often, it did not happen. Mothers who stay in their jobs, or get a job at some point, report that they often do not work full time, often have to be absent from work, or do not do their full potential because they are too tired (Gray, 2003). Milačić-Vidojević confirms a similar situation regarding Serbia. Fathers rarely leave their jobs to stay home and take care of the child, while mothers fully devote themselves to the child (Milačić-Vidojević, 2008).

Research shows that, in relation to fathers, mothers most often seek support and assistance from their partners, friends, relatives, other parents, and professional services and experts (Gray, 2003).

The best strategy to cope with the various difficulties and stress for parents of children with ASD is thought to be social support (Brown, 2014). However, social support can also be a source of various problems. Parents of children with ASD often have the problem of not being informed about the various services available, the financial problem of paying for these services or treatment, or the problem of establishing adequate communication and collaboration with service providers (Mandell & Salzer, 2007). These parents are often members of different social support groups, which gives them a sense of belonging within a circle of people in a similar situation (Brown, 2014).

Online social support is increasingly popular today. Research shows that this type of support is also used by parents of children with ASD. It allows them to receive the emotional support they lack from their family, relatives, or friends. Also, in this way, they can get the information they need, or that could be helpful from the people facing similar or same difficulties (Reinke & Solheim, 2015).

In recent years, an increasing number of projects, programs and interventions have been organized aimed at learning about and enhancing the knowledge about the ASD, understanding the needs of these individuals and their families, and enhancing the child's capabilities and skills (Mereoiu et al., 2015). One of the ways that parents of children with ASD can be assisted is by teaching them the methods that can enhance their child's development and improve their behavioral characteristics. It also extends teaching methods that can help parents themselves adequately cope with the difficulties and stress they encounter (Anderson & Smith, 2014).

Problems and support for parents of children with ID

The moment of getting the diagnosis is accompanied by feelings of sadness, hopelessness, loss and resentment for the parents of children with ID (Aldosari & Pupaff, 2014). As parents of children with ASD, the parents of children with ID go through several stages, after finding out their child's diagnosis. There are five such phases in the literature: 1) shock and negation; 2) anger and resentment; 3) negotiation; 4) depression and hopelessness and 5) acceptance and adjustment (Cavkaytar, Ceyhan, Adıgüzel, & Uysal, 2012).

According to the studies, the impact of the clinical picture of ID on parents is different. In one study, 55.38% of parents stated that they thought their child with ID had a positive effect on the whole family. Parents stated that having a child with ID led them to develop patience, tolerance, empathy, sensitivity and that their marital relationship improved (Indla, Indla, & Singh, 2008, according to Aldosari & Pufpaff, 2014). Some parents feel that, thanks to their child with ID, they have begun to appreciate the little things they once took for granted (Aldosari & Pufpaff, 2014). Other research supports the fact that parents of children with ID have more negative than positive parenting experiences and that the stress that comes from caring for a child with ID can affect the physical, cognitive and emotional aspects of all family members (Azar & Badr, 2010).

Sources of difficulties for parents of children with ID are complex, interrelated and influenced by a number of factors. Parents of children with ID cite challenging behaviors and changes in their child's sleep, social isolation, inner family disputes, and financial problems as sources of difficulty (Dempsey, Keen, Pennell, O'Reilly, & Neilands, 2009).

Children with ID often need hospitalization, medical care, special development services, and more specific care than children of the typical population. These requirements can be a great source of difficulties for parents of children with IDs in terms of financial problems, time constraints, and parents' doubts about their ability to meet their child's specific needs (Gerstein, Crnic, Blacher, & Baker, 2009; Nachshen, Garcin, & Minnes, 2005).

Parents of children with ID have poor social network (van Asselt-Goverts, Embregts, & Hendriks, 2015). Research shows that these parents often have marital problems, and that the mutual support between spouses is very poor. A child with ID affects the functioning of the whole family as well as siblings (Aldosari & Pufpaff, 2014). Parents of children with ID, same as parents of children with ASD, have an unequal distribution of child-related responsibilities, and thus the mother most often plays a dominant role in the care of the child (Azar & Badr, 2006). The support they receive from their partners is very important for parents of children with ID, and when that support exists, it helps them to more adequately cope with various difficulties (Kilic, Gencdogan, Bag, & Arıcan, 2013; Wieland, & Baker, 2010).

Numerous authors believe that it is necessary to collect information on the needs of the entire family who have a child with ID in order to identify appropriate support services that will improve their quality of life (Cavkaytar et al., 2012). If the support provided is not adequate, parents are very dissatisfied and stressed (White & Hastings, 2004). One study state that different support services often do not take into account the needs of a family with a child with ID and are not sensitive to the problems these families face (Nachshen, 2005).

The type of support is important for the parents' adaptation process and the level of their satisfaction with the support. The results indicate that informal support is most effective and that this type of support can compensate for parental dissatisfaction arising from the influence of experts, professional office and services (Hastings, Allen, McDermott & Still, 2002). Parents of children with ID state that they need emotional support from close people in their environment, professional help in dealing with various psychological problems, and different resources of social support (Cavkaytar et al., 2012).

INSTEAD OF A CONCLUSION

A quality support program for parents would include: accessibility in all local communities, not just in major cities; education on ND and the impact of diagnosis on child development; redefining parental role and quality child care with ND.

When planning support, it is necessary to identify and describe the type and intensity of support needed, and to include in the support process those services that will mitigate or eliminate the differences that exist between the individual level of functioning of the child with ND, the parents' problems and the demands of the setting environment. In our country, more support from all levels of government is needed in order to improve the network of different services.

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SPECIFIC SURGERY METHOD FOR TREATMENT OF PATIENTS WITH CEREBRAL PALSY

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SUMMARY

The aim of this research was to evaluate the efficacy of the specific surgery method, called Ulzibat® surgery method, in the rehabilitation of children with cerebral palsy. 83 patients, aged 2.6 to 13.4 years with spastic cerebral palsy participated in this study. The average course of treatment was 2 stages. The follow-up period was 2-5 years. GMFM-88 was used to assess the degree of motor disorders before and after treatment. Patients before and after surgical treatment were divided into 5 groups of levels of motor activity. Results showed that, after treatment, there was a significant increase in total score in average by 23 points in all observed group. There were a positive correlation between the difference in scores before and after treatment and the level of motor skills ($p<0.05$) and a negative correlation with age of operation ($p<0.05$). Most children after surgical treatment moved to a higher level of physical activity. The number of children with minimal disruption in motor activity (1st group) after treatment has doubled, and the number of children with the most severe disorders (4th and 5th group) was halved. Most of the children showed improvement either within their group movement activity (39%) or transition on level 1 above (49%). 12% of patients were passed on 2-4 levels above. It can be said, that this surgery method has shown high efficiency in the rehabilitation of children with cerebral palsy with different the severity of the disease. The most pronounced effect noted in the course of surgical treatment at an early age (3-7 years).

Key words: cerebral palsy, surgery, rehabilitation, Ulzibat method, gradual fibrotomy

INTRODUCTION

The main method of treatment for the patients suffering from neuro and musculoskeletal system pathologies used in the Institute of Clinical Rehabilitology in Tula, Russian Federation, is a unique surgical technique - phased (step-by-step) fibrotomia (PFT) which was invented and put into practice by Professor V.B. Ulzibat, PhD**.** The essence of the phased fibrotomia lies in a special method of discussion of the muscles pathologically changed areas (scars) by a specially designed scalpel, which allows avoiding large skin and healthy muscles discussions and is aimed at elimination of local muscular contractures and pain syndrome with minimum possible discomfort for the patient. Such surgeries leave no scars on the patient's body, but only punctures after the scalpel insertion. The surgery is performed in the quickest and safest possible way for the patient, which minimizes the time of being anesthetized and, most significantly for the children, the stress. Besides, the advantages of phased fibrotomia in comparison with the other surgical methods of treatment on skeletal muscles are:

1. Low possibility of injury

As distinguished from classical surgery techniques (subdermal myotomy, tenomyotomy) and their variations, the phased fibrotomia is performed with a reduced impact, without skin discussions, only in the in the scar area in a healthy muscle sparing way. No complete muscle incision or work operation on tendons or bones is performed. After surgery no plastering should be made. The surgical wounds are easy to take care of for every patient.

2. Method versatility

This method allows performing surgeries on any superficial muscle and such technique is used for different musculoskeletal system diseases due to development of similar changes in muscular tissues under the influence of different causative factors (trauma, infections, allergens, toxins, etc.).

3. Short time of the surgery

There is no need of using auxiliary complex equipment and additional procedures in the process of the surgery resulting in significant increasing of the surgery time and the patient's being anesthetized which eases the patient's postanesthetic state and decreases greatly possibility of post-surgery complications.

4. No hospitalization

The surgeries are performed at „one-day hospital" which facilitates quick recovery under familiar home conditions.

5. No contraindications

There are no contraindications related to early age of the patients and to concomitant hyperkinetic, convulsive, hydrocephalic, asthenic syndromes, to mental and physical retardation, compensated chronic diseases and congenital anomalies (hydrocephalus, heart disease, stridor, etc.) (availabe at https://www.ulzibat.ru/en/method/).

At the average, about 3500 patients are operated annually. 86.6% of all the clients are the children suffering from cerebral palsy. Among all the operated 79.8% are the people with spastic tetraparesis and with spastic diplegia. 94% of patients have mean and advanced degrees of motion disorders, 97% of the patients have a stable recovery effect, 71% of the patients note the positive result and return to this method again.

The infantile cerebral palsy treatment has several stages. On each stage, the necessary amount of muscular and fascial contractures is debrided at a time under general anesthesia, so the number of PFT performed under local anesthesia varies from 4 to 6 per each stage. On each stage, an agreement is reached with a patient or his representative (a parent) about the surgery plan and execute the relevant documents.

The time of the next surgery stage depends upon the movement disorders complexity, on the presence of associated diseases and on the development rate, applise to children.

Due to low possibility of injury, postoperative recovery of motion functions shortens significantly – from 5-7 days to 3-4 weeks. This depends on the gravity of the surgery.

The removal of muscular contractures and pain syndrome enables substantial increase of the range of motions. It helps to receive new motion skills and to improve the existing ones. The increase of the overall motion activity stimulates mental development, broadens the scope of interests, betters self-service skills. In difficult cases, it makes the nursing considerably easier.

The surgical treatment high effectiveness and the applied techniques uniqueness attract people from various cities of the Russian Federation and from near and far-abroad countries (Ukraine, Belorussia, Moldova, Kazakhstan, Uzbekistan, Kirghizia, Georgia, Armenia, Azerbaijan, Estonia, Latvia, Lithuania, Spain, Greece, Serbia, Montenegro, Croatia, Bosnia and Herzegovina, Slovakia, Egypt, Finland, Italy, Poland, Germany, Sweden, United States of America, Israel, India, Argentina, Australia, Venezuela, Mexico, Great Britain, Canada, etc.).

During the last twenty years, in The Institute, more than 40000 patients were admitted for the treatment, and about 81% of them were children. An average of 4000 patients per year were operationally treated, and more than 2000 of them applied for the first time, including 82% of children.

The age structure of all patients admitted for the treatment of locomotor system pathology was the following: 1–3 years: 14.4%; 4–7 years: 36.3%; 8–10 years: 14.8%; 11–14 years: 15.4%; 15–17 years: 17.7%; and older than 18 years: 1.4%.

The largest group of patients includes people with the incoming diagnosis of “infantile cerebral palsy”. The patients with cerebral palsy accounted for 84.3**%** of total patients number. Among patients with infantile cerebral palsy, 86.9% were children. The following age distribution of patients with infantile cerebral palsy was determined: 1–3 years: 16.3%; 4–7 years: 40.2%; 8–10 years: 16%; 11–14 years: 15.3%; 15–17 years: 11.9%; and older than 18 years: 1.2%. The structure of patients according to the type of infantile cerebral palsy was the following: the double hemiplegia: 42%; spastic diplegia: 36.7%; hemiparetic form: 13.3%; hyperkinetic form: 6.3%; atonic-astatic form: 1.5%. Patients with severe and moderate level of motoric disorders were prevailing.

The analysis of treatment results of 3849 patients over a long period of time, compiled by the doctors from different cities of Russia and the experts of the Institute in the period from the year 1993 till 2011, showed that on average of 92.8% of cases has achieved *a good clinical effect* which is manifested through the increasing range of motion, the emergence of new or substantial improvement of previously existing motor habits, the forming of a qualitatively new motoric stereotypes, and the disappearance or reduction of pain syndrome and hyperkinesia. In the case of 4.3% of patients *satisfactory result* was found, the improvement of individual motor habits was noted, and also the expansion of the features within the initial level of motor development. In the case of 2.8% of patients, their condition was *“unchanged”*. In the case of 0.03% of patients, the occurrence of pain in the muscle areas that were not previously operated, was considered to be *the deterioration*, however, these changes were eliminated in the following phases of treatment. In 52% of cases, the motor function changes had a qualitative character and were manifested through the development of new habits (sitting, crawling, walking, self-service habits). The effectiveness of phase fibrotomy in relation to local organic muscle contracture or the pain spot was 97.5% in average (Nazarkin, 2012).

The afterhistory analysis made by independent medical experts from different cities of Russia and by the Institute staff shows that it can be seen the constant improvement in the general clinical performance. The increased range of motions, the onset of new movement skills and the improvement of existing ones were considered to be the cure rate. In the definite period of treatment 10 – 18% of patients had no substantial changes, 1 – 3% suffered from pain on the muscle zones which hadn’t been operated on before. This medical phenomenon was considered to be the deterioration. The changes connected with pain were temporary and were eliminated on the following stages of treatment. In accordance with pain and muscle contracture localization the effectiveness of phased fibrotomia was 97.5%.

Furthermore, it was notice supplementary positive effects such as: the improvement of speech (62%), mastication (49%), swallowing (50%), emotional and behavioral indexes (64%), memory (37%), attention (41%), sleep (49%), appetite (58%), the decrease of strabismus (55%), nystagmus (22%) and salivation (56%), the improvement of visual (17%) and hearing acuity (15%), the normalization of urination and defecation (28%) (Nazarkin, 2012).

Having observed the patients during 24 years, it can be confirmed that the optimum time for the operation is the stage of the early muscle contractures onset before the occurrence of persistent contractures and joints deformations. In this connection it's highly advisable if you wish to get positive permanent results quickly with minimum number of operations, you should begin the surgical treatment in the early age (from 3 to 5 years).

Also, katamnestic monitoring of patients during the period of 20.5 years confirms that the surgical procedure is optimal at the early stages of organic muscle contractures, before the occurrence of persisting contractures and deformities of locomotor apparatus. In relation to this, in order to achieve the maximum results, in the cases of adequate indications, it is the most appropriate that surgical treatment starts at age of 2–3 years of life when pathology is congenital, and at age of 3–5 years of life when it comes to acquired pathology of the locomotor apparatus and infant cerebral palsy.

The qualitative characteristics of technology "Phase Fibrotomy in Orthopedics" are following:

- universality in terms of nosologically different types of locomotor pathology related to the unity of the mechanisms of development of identical processes in muscle tissue (dystrophy, necrosis, sclerosis), whose outcome is the forming of organic muscle contractures, irrespective of the type of primary etiological factor;
- functionality which is provided by the simultaneous action on different muscle groups taking into account their synergism and antagonism, the possibility of a combination of operations on all superficial skeletal muscles of the head, trunk and extremities in order to achieve maximal effect;
- minimally traumatic which is achieved through precise movements of specially constructed scalpel; absence of skin excision, blood loss, and complete muscle excision and transplantation, there is no working on tendons and bones, and subsequent cast immobilizations are unnecessary, which all further contribute to the shortening of the recovery period and a patient's early activation after surgery;
- the possibility of working *in the outpatient setting* which contributes to faster recovery under the conditions that are usual for the patient (Nazarkin, 2012).

This method has some specific indications and contraindications for applications.

The following indications to treatment according to V.B. Ulzibat's technique are determined:

- presence of organic muscle contractures and chronic myofascial pain syndrome;
- absence of effect of the conservative therapy application.

Absolute contraindications for surgery are considered to be the following:

- presence of developmental disorders and chronic diseases in the stage of decompensation;
- dysfunction of vital organs.

Relative contraindications for surgery are:

- acute infectious and somatic diseases, including the reconvalescence period;
- acute and subacute period of neuroinfection, head injury and cerebral vascular disorders;
- chronic disease in the deterioration period;
- intolerance of medical anesthesia products;
- presence of severe allergic reactions in anamnesis;
- presence of injuries, inflammatory skin and soft tissue diseases;
- post spastic seizure status: after the “small” seizures – at least 3 months, after the “big” (generalized) seizures – at least 6 months; after status epilepticus – at least 12 months;
- status after the Botox intervention (Dysport) – at least 6 months;
- status after vaccination – at least 1 month (Nazarkin, 2012).

Cerebral Palsy

Cerebral palsy (CP) is the one of the most commonly occurring childhood physical disability (Benfer, Jordan, Bandaranayake, Finn, Ware, & Boyd 2014). There is no precise definition of cerebral palsy. The diagnosis is understood as symptomatology of chronic disorders of movement function. Cerebral palsy is caused by brain damages, and the causes of cerebral palsy can be obvious and hidden. In some cases several risk facts simultaneously can cause the disease. More than 100 potential causes lead to cerebral palsy. They can be integrated into three large groups:

1. Pregnancy course. This group of causes includes Rh incompatibility, hereditary diseases, placental insufficiency, as well as infectious diseases (herpes, rubella, etc.) which adversely affect the child’s brain, chromosomic mutations, hypoxia, and ischemia (MacLennan, 1999).

2. Childbirth. Quick and prolonged uterine contraction/strains can cause cerebral palsy. Risk factors also includes the following: medical labor induction, premature birth, artificial rupture of membranes, abnormal presentation, heavy fetal weight, lack of oxygen, placenta abruption, suffocation due to cord entanglement, obstruction due to contracted pelvis (Stanley, Blair, & Alberman, 2000).

3. Newborn adaptation period (from 4 weeks to 2 years). External factors can negatively affect the child. Some of them can be avoided or minimized. This risk group includes head trauma, neuroinfection (meningitis, encephalitis), poisoning with chemicals, brain hypoxia (Stanley et al., 2000).

Severity level, character, volume of these damages and the precise location of brain injury determine the form of disorders of muscular structure and total body function. Types of Cerebral Palsy are:

- Spastic quadriplegia;
- Spastic diplegia;
- Hemiplegia;
- Dyskinetic (hyperkinetic) type;
- Extrapyramidal form;
- Atonic - astatic form.

The most common form of cerebral palsy in all age groups is the spastic form, which occurs in 80% of cases (Van Naarden Braun, Doernberg, Schieve, Christensen, Goodman, & Yeargin-Allsopp, 2015). The prevalence of cerebral palsy is 2-4 cases per 1,000 children (Benfer et al., 2014; Van Naarden Braun et al., 2016).

High prevalence of cerebral palsy, the severity of clinical manifestations, early disability patients make the problem of treatment of patients with this pathology is extremely relevant and socially important. Rehabilitation of children with cerebral palsy is a lengthy and time consuming process, due to the early formation of pronounced contractures and the formation of vicious poses.

Cerebral palsy can be recognized for the number of core symptoms:

- muscle hypertonia;
- uncontrolled contraction of any muscles;
- uncontrolled involuntary movement;
- restriction of joint movement;
- muscle hypotonia (Reddihough & Collins, 2003).

Symptoms are also often accompanied by impairment of vision and hearing loss, or delay in brain development. Additionally, people with cerebral palsy can have such symptoms as mental and psychic disorders, speech disorders, epilepsy, convulsions, gasp, swallowing difficulties and more (Sewell, Eastwood, & Wimalasundera, 2014).

Treatment of the children with cerebral palsy should begin immediately upon its diagnostic and carry out throughout life. This is of particular importance to do everything possible to support and recover the brain function under the age of 8 years. During this period, the child is vulnerable and able to adapt to life in society.

Causes of cerebral palsy can be different, but in any case the child should undergo the rehabilitology courses and be under continuing medical supervision.

Treatment for CP necessarily includes exercise therapy, physical therapy, Vojta method, massage, Bobath therapy, systematic work with a speech language therapist and a psychologist.

The method of treatment for children with cerebral palsy

One of the modern effective surgical treatments for the effects of cerebral palsy is GRADUAL FIBEROTOMY BY V.B. ULZIBAT. The Institute of Clinical Rehabilitology offers this unique method of treatment of the cerebral palsy consequences, manifested in impaired motor functions. The Institute accepts patients with spastic and hyperkinetic forms of cerebral palsy.

Surgical removal of contractures by this method allows in short terms to increase the amount of motion in the joints, improving motor function in the affected segment, reducing pain, improving the quality of life of patients and facilitating the care of patients with severe form of the disease. In addition, the technique is minimally invasive (Nazarkin & Eremin, 2016).

As mentioned, the method of gradual fibrotomy is a way to remove muscle contractures and myofascial pain syndrome, based on gradual subcutaneous decision of fibrously modified muscle fibers using a special scalpel. Pathogenetic substantiation used for the surgical treatment of patients with congenital and acquired disorders of the musculoskeletal system by Ulzibat® method were the results of clinical and instrumental and morphological studies conducted by the Institute with the participation of independent medical experts. It was established that one of the causes of muscle dysfunction, myofascial pain and movement disorders in various diseases of the musculoskeletal system is the development of skeletal muscle in dystrophic and sclerotic changes. Exodus expressed dystrophic process is the fibrosis of the muscle fibers, the formation of organic muscular contractures - fixed shortened and compacted muscle areas, painful on palpation and does not disappear when the muscle relaxation (Ульзибат, 1993).

The ultimate goals of surgical treatment by the Ulzibat® method are to increase volume of movement in joint, to prevent development of heavy bone and joint deformation, to decrease hidden and explicit pain syndrome.

This method has many undeniable advantages: Low possibility of injury; Short time of the surgery; No post-surgical sutures and scars; No post-surgical plaster immobilization; No hospitalization; Successful treatment in more than 97% of cases.

In addition the patient does not need a long time to stay in the hospital, he can be discharged the next day after surgery. Also the next day after surgery patient can seat and move in the bed without any restriction. Through 3-5 days after surgery patient can crawling, and through 14 days can stand on feet. Active rehabilitation is possible in one month since the operation.

Of course as with any surgical procedure there may be some complications: postoperative hematoms in operated zone (20-30%), the treatment of which typically requires only the application of alcohol compresses; anesthesiological complication (2-5%); injury of main blood vessel (less 1%); injury of main peripheral nerve (less 1%).

It is important to understand that cerebral palsy treatment should be complex and include combination of conservative and surgical methods. Children rehabilitation should be provided permanently. In addition, while growing -up of the child the surgical correction of movement disorders should be performed. And then you can achieve really good results and bring children with cerebral palsy back to normal social life.

Over 25 years of existence method, operated on more than 45000 patients with diseases of musculoskeletal system (over 37000 children), of which 84.5% of the patients with cerebral palsy.

Therefore, the aim of this research was to evaluate the efficacy of the Ulzibat® surgery method in the rehabilitation of children with cerebral palsy.

METHOD

Participants

Research involved 83 patients, aged 2.6 to 13.4 years with spastic forms of cerebral palsy. The average course of treatment was 2 stages. The follow-up period was of 2-5 years. To assess the degree of motor disorders before and after treatment used the conventional scale GMFM-88 (Alotaibi, Long, Kennedy, & Bavishi, 2014) to assess motor 88 acts on 5 categories: A – lying and rolling, B - seating, C - crawling position on knees, D – standing, E – walking, running, jumping. The total score was calculated in % of the maximum score. Patients before and after surgical treatment were divided into 5 levels of motor activity:

I Sitting, alone gets up and walks without additional support, runs, climbs the stairs;
II Difficult to balance when sitting, stands up independently, crawls, walks with additional support;
III Sits up with help, crawls, walks a few steps with additional support;
IV Sits down and sits with assistance, move around the room by rolling or crawling, not walking;
V Limited all levels of movement, not sitting, not crawling, not walking.

For different age groups, there are certain criteria for the distribution of motor activity through the levels.

Statistical analysis

Statistical processing of the obtained data was performed using the statistical software package Statistica 6.0 (USA). Data are represented as mean values. To compare two dependent samples qualitative test was used χ^2. To analyze the relationship of the two signs was used in the analysis of rank correlation by Spearman. For all benchmarks and tests differences were considered significant at $p<0.05$.

RESULTS AND DISCUSSION

The study involved 83 participants divided in 5 groups according to the clinical characteristics and levels of physical activity.

After treatment in all groups we observed a significant increase in total score ($p<0.05$) in average by 23 points. The total difference scores were higher, the worse the initial level of patients (Figure 1). So, in group I with minimal motor impairment total score increased by an average of 17 and has almost reached 100. In group II was also observed almost complete restoration of motor skills, the total score increased by an average of 18, from 78 to 96 points. In III, IV, V groups, the total score increased by 26, 29 and 23, respectively. In the first groups, a small difference in scores due to the initially mild loss of motor skills in patients, that is, the children in these groups after treatment reached normal or near normal physical activity. But, obviously a significant improvement of motor skills in children with severe impairments.

Table 1. *The distribution of patients according to level of physical activity before surgery and their clinical characteristics*

	Level of physical activity				
	I	II	III	IV	V
N	15	15	19	16	18
Mean age (min-max)	5.5 (3.1-13.1)	5.8 (2.6-13.4)	4.9 (2.6-8)	6.1 (3-10.5)	4.5 (2.7-6.3)
Spastic tetraparesis	1	0	5	8	12
Spastic hemiparesis	9	4	0	0	0
Spastic diplegia	5	11	14	8	6
The average score before treatment (min-max)	80 (63-92)	78 (61-87)	62 (50-72)	46 (26-57)	17 (2-40)

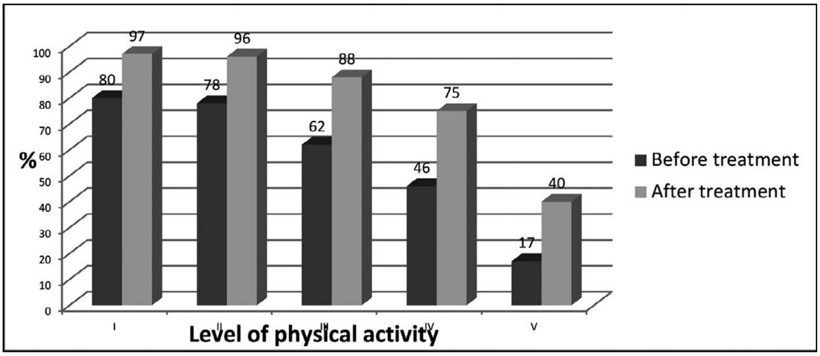

Figure 1. The total score of the motor activity before and after treatment by the Ulzibat® method in the patients of 5 groups.

Correlation analysis confirms a direct positive relationship between the difference in scores before and after treatment and the level of motor skills ($r_S = 0.4$ $p < 0.05$). Also revealed a negative significant association between the difference score before and after treatment and age of operation ($r_S = -0.5$ $p<0.05$). Thus, the sooner the surgery is performed, the better the treatment outcome. As a result of this treatment changed the distribution of children into groups according to level of motor skills (Figure 2). Most children after surgical treatment moved to a higher level of physical activity. So, if before the treatment in the 1st group with a minimum of movement disorders was 18% of children after treatment, this group made up the majority of patients – 40%. In addition, we see significant improvement in the group of children with low movement (V group). After surgery, the percentage of children in this group was halved, from 22% to 9%.

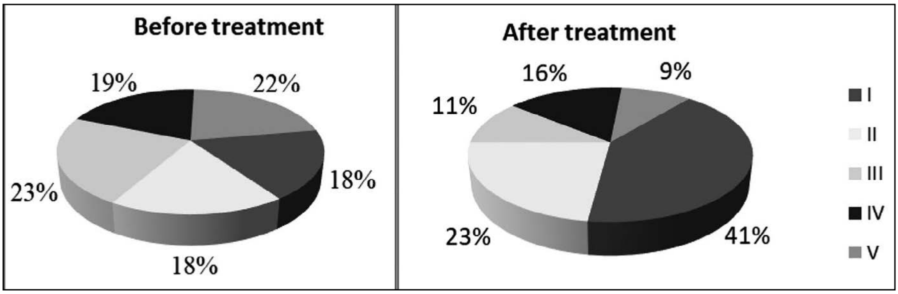

Figure 2. The distribution of patients by levels of motor activity before and after treatment by the Ulzibat® method

It should be noted that the degree of improvement of motor skills in children was different. Most of the children showed improvement either within their group movement activity or transition on level 1 above (Table 2). So, 39% of children improved their performance, but remained in the same group, and 49% improved the performance so much that switched to 1 level up. A lot of children, 8.4% moved to 2 levels above. Also 3 children of the 83 showed so marked an improvement in the movement skills that were passed on 3 and 4 levels above.

Table 2. *Distribution of patients according to the degree of improvement in motor activity after treatment*

The degree of improvement of motor skills	The number of patients	% patients
Within the initial level	32	38.6
With the transition to the 1 level up	41	49.4
With the transition to the 2 level up	7	8.4
With the transition to the 3 level up	2	2.4
With the transition to the 4 level up	1	1.2

The degree of improvement of motor skills (within initial level and with the transition to a higher level) in five groups of patients is presented in figure 3. In group 1 with minimal disruption, all 15 patients showed improvement of skills within their group. In 2 group 80% of patients moved on his movement skills in group 1. In group 3, more than 70% of patients after treatment have moved to the second group, 15% to the first. In 4 group – third of children improved motor skills within its group, a third – moved to the group above, almost 20% – is moved to the second group, and 2 children moved to 1. In the 5, the heaviest group, about 40% of children improved their performance within their group, just over 40% moved to level 4, 2 kids - third level, and 1 patient at fist level.

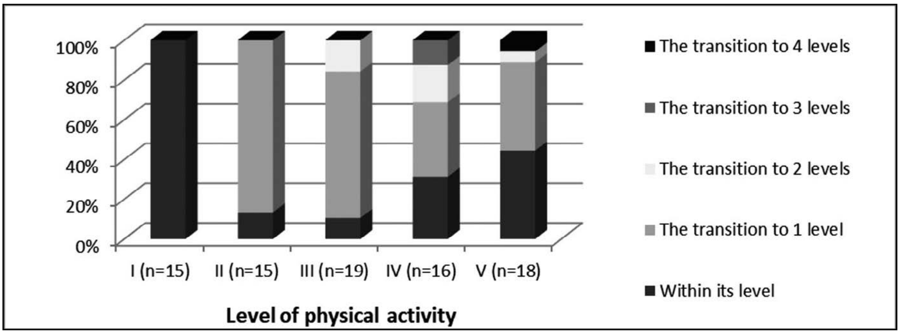

Figure 3. Improved motor skills after treatment in patients with different initial levels of physical activity.

CONCLUSION

The Ulzibat® surgery method has shown high efficiency in the rehabilitation of children with cerebral palsy. Improving motor skills is noted in patients of all 5 levels of physical activity. Even in patients with severe motor disabilities there is a strong positive trend. The method is effective in any age period, but more pronounced results are achieved in the age group of 3 to 7 years. The advantages of the method – quick increase of volume of movement in joints after elimination of muscle contractures, which in addition to pronounced self-effect, significantly increases the effectiveness of other rehabilitation measures, and potentiates their action. In addition, an unquestionable advantage of the method is it's minimally invasive, especially given the large percentage of children of small age and concomitant pathology. Given the above advantages, we can assume high economic efficiency of the method by reducing the duration of treatment, a pronounced effect recovery of motor function with a decrease in the degree of physical disability. It should be noted that simultaneously with the return of motor activity from a large number of patients showed improvement of speech, intellectual-mnestic functions, the acts of chewing and swallowing. Such observations suggest that the improvement of motor function, reduction of pain syndrome leads to the activation and functioning of the entire nervous system, not just the motor center responsible for the segments subjected to surgical interference. However, this assumption needs further detailed research.

Thus, the Ulzibat® surgery method being high-effective and minimally invasive, can be widely put into practice in patients with cerebral palsy that will accelerate and facilitate subsequent rehabilitation.

And finally, it should be noted that comparative analysis of the effectiveness of treatment of children with disorders of locomotor apparatus and infantile cerebral palsy from different age subgroups showed that the percentage of positive results in pre-school children is higher than in older children. Reason for this lies in more pronounced changes in the muscles of school-aged children and older boys and girls, and also in the forming of fixed deformation of locomotor apparatus over time. A higher efficacy of the treatment of patients with spastic types of infantile cerebral palsy, and in the cases of moderate motoric disorders, unless there are changes in the joints, or they are minimal, was found.

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EDUCATIONAL NEEDS OF CHILDREN WITH RARE DISEASES AND LONG-TERM HOME VENTILATION (SMARD1) - CASE STUDY

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SUMMARY

Diagnosing a child with a rare disease that involves acute respiratory distress dramatically changes his/ her educational situation. Therefore, it is important to determine the child's educational needs which will help select an adequate teaching strategy. One of such diseases is Spinal Muscular Atrophy with Respiratory Distress Type 1 (SMARD1). In Poland, two children were diagnosed with it, whereas around the world there are over 60 cases. The study encompasses one boy with SMARD1. The purpose of the study was to describe the child's educational needs, as well as to indicate which of them are related to the rare disease and which to respiratory distress that requires mechanical ventilation. Based on the performed study, it was concluded that not all educational needs related to the rare disease were present. On the other hand, all needs related to home ventilation were present.

Key words: children with educational needs, Spinal Muscular Atrophy with Respiratory Distress Type 1, rare disease

INTRODUCTION

Researchers of various academic disciplines, including teachers, speech therapists, sociologists and psychologists started to tackle the issue of education of children with rare diseases more and more frequently. Most often, such studies refer to a specific disease. In spite of the increasing interest in this subject, academic publications describing educational needs of children with rare diseases and home ventilation are still missing. In the conducted study, the author assumed that "a rare disease is a health condition that affects a small number of people compared with other prevalent diseases in the general population. To date, between 5000 and 8000 distinct rare diseases have been documented" (Richter, Nestler-Parr, Babela et al., 2015: 2). Prevalence of a rare disease may vary, depending on the continent, country and region. In one state, it may be a rare disease, whereas in another one a disease with high prevalence. In Europe it is assumed that a rare disease affects 5 out of 1000 people. Thus, it may be concluded that in the European Union, there are 26-27 million people suffering from such diseases, whereas in the United States, 25 million people with such diagnosis (Richter, Nestler-Parr, Babela et al., 2015). The author also assumed, following Isobel Brooks, that long-term ventilation (LTV) is: "dependence on mechanical ventilation, whatever the interface, for all or part of a 24 hour period, for at least the last three months, in a medically stable child or young person." The term LTV is generally used to describe patients where the intention is to deliver ongoing ventilation at home. The interface used to deliver ventilation is either a tracheostomy - so called "invasive ventilation", or a mask (which may be full face, nasal, mouthpiece or face-shield) - "non invasive ventilation" (Brooks, 2019: 167).

Spinal Muscular Atrophy with Respiratory Distress Type 1 (SMARD1) is a rare disease and its exact prevalence remains unknown. So far, over 60 people have been diagnosed around the world (Eckart, Guenther, Idkowiak et al., 2012). At the present moment in Poland, there are two children with SMARD1 (four cases were diagnosed, two children died). It is inherited in an autosomal recessive pattern. SMARD1 is known to be caused by changes (mutations) in the IGHMBP2 gene (Grohmann, Schulke, Diers et al., 2001). Symptoms are already noticeable in the pre-natal period. Almost 1/3 of children are born prematurely, most often in the 37th week of pregnancy (some sources inform about 34th – 35th week of pregnancy). Other characteristics include low birth weight and weak sucking reflex (Porro, Rinchetti, Magri et al., 2014). SMARD1 symptoms may be classified into three groups: respiratory tract, nerve and muscle system and autonomous and sensory nervous system (figure 1). The first symptoms include respiratory distress along with progressing muscle weakness. Based on case studies, the researchers noted that frequent symptoms of respiratory distress include inspiratory stridor and/ or silent cry. As noted by Porro et colleagues it is also significant that "the diaphragmatic paralysis arises as dyspnea, with eventration of one or both hemidiaphragms and ultimately requires permanent respiratory support" (Porro, Rinchetti, Magri et al., 2014: 36). As far as muscle weakness is concerned, it initially affects distal muscles. It is usually more intense in lower extremities. Additionally, children may manifest elevated pain threshold, neurogenic bladder, elevated liver enzyme levels, problems with gastrointestinal system and cardiological problems (Porro, Rinchetti, Magri et al., 2014).

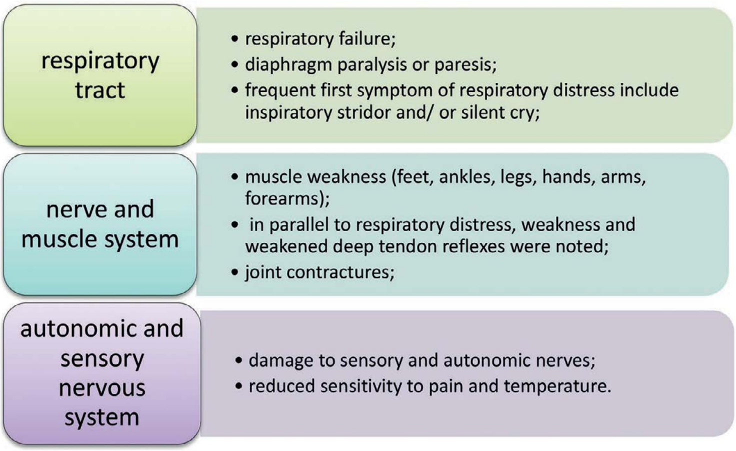

Figure 1. Spinal Muscular Atrophy with Respiratory Distress Type 1 clinical signs and symptoms Source: M. Jędrzejowska (2010). *Przeponowa postać rdzeniowego zaniku mięśni (SMARD1)*, Neurologia Dziecięca, vol. 19 (38), pp. 51-54, K. Grohmann, R. Varon, P. Stolz at al. (2003). *Infantile Spinal Muscular Atrophy with Respiratory Distress Type 1 (SMARD1).* American Neurological Association, Vol. 54, No. 6, pp. 719-724, A. M. Kaind, U. P. Guenther, S. Rudnik-Schöneborn at al. (2008). *Spinal Muscular Atrophy with Respiratory Distress Type 1 (SMARD1*). Journal of Child Neurology, Vol. 23, No. 2, pp. 199-204.

Child With a Rare Disease and Home Ventilation Vs. Education

The priority, as far as care for a child with mechanical ventilation is concerned, is stabilisation of the child's health condition. This allows for the child's discharge from a medical facility where he/ she was subject to intense paediatric care to home environment. The stage of health condition stabilisation is a time deprived of experiences that allow for the child's development. Return home is difficult, because the time of hospitalisation could have exposed the child to improper types and levels of stimulation, which is related to the absence of positive and adequate experiences based on interactions with other persons. Thus, intensive medical care in hospital conditions cannot provide support in the realm of developmental, social and educational needs (Hewitt-Taylor, 2004).

Anna Ludvigsen and Jan Morrison, based on a study performed in the area of Great Britain focused on support for children with home ventilation, indicated problems that such children may experience. Among them, the following ones were listed:

- "Barriers to discharge resulting in prolonged hospitalisation, in particular delayed transfer from intensive care, and increased risk of infection,
- Negative impact on quality of life, in particular privacy and dignity and effect on independence,
- Lack of consistency in short break respite provision" (Lawrence 2011: 20; Ludvigsen & Morrison, 2003: 3).

The situation is even more complicated when the child has been diagnosed with a rare disease and participates in clinical trials or undergoes experimental treatment. Frequency of hospital stays related to it, as well as the fact that the child is primarily surrounded by adults may lower the level of the child's psycho-social functioning. Return home is also often related to the commencement or continuation of the interrupted educational process, both on the pre-school and school level. The majority of children with mechanical ventilation are provided with individual teaching or they attend integration kindergartens or schools.

Educational Needs of a Child With Rare Disease and Home Ventilation

Thinking about educational needs of a child with difficulties in development and/ or a disability is changing. This results, among others, from the fact that the modern studies provide us with medical data and information pertaining to the development of cognitive functions which supplement the hitherto level of knowledge about the disease or overthrow existing theories about it. This also translates to the education of children with disabilities, as well as the process of their therapy. In literature, educational needs of children with difficulties in development are called special educational needs (SEN) and are defined as: "... a restriction in the capacity of the person to participate in and benefit from education on account of an enduring physical, sensory, mental health or learning disability, or any other condition which results in a person learning differently from a person without that condition" (Griffin, 2014: 10).

In individual countries, definitions of SEN may vary, yet their common element is the fact that they refer to students who experience difficulties - in contrast to their peers - that make learning difficult for them, at every stage of education, also pre-school education (Malbogat, 2017). The aforementioned difficulties may refer to, among others: hearing and sight defects, neurological disorders, movement disorders, etc. (figure 2).

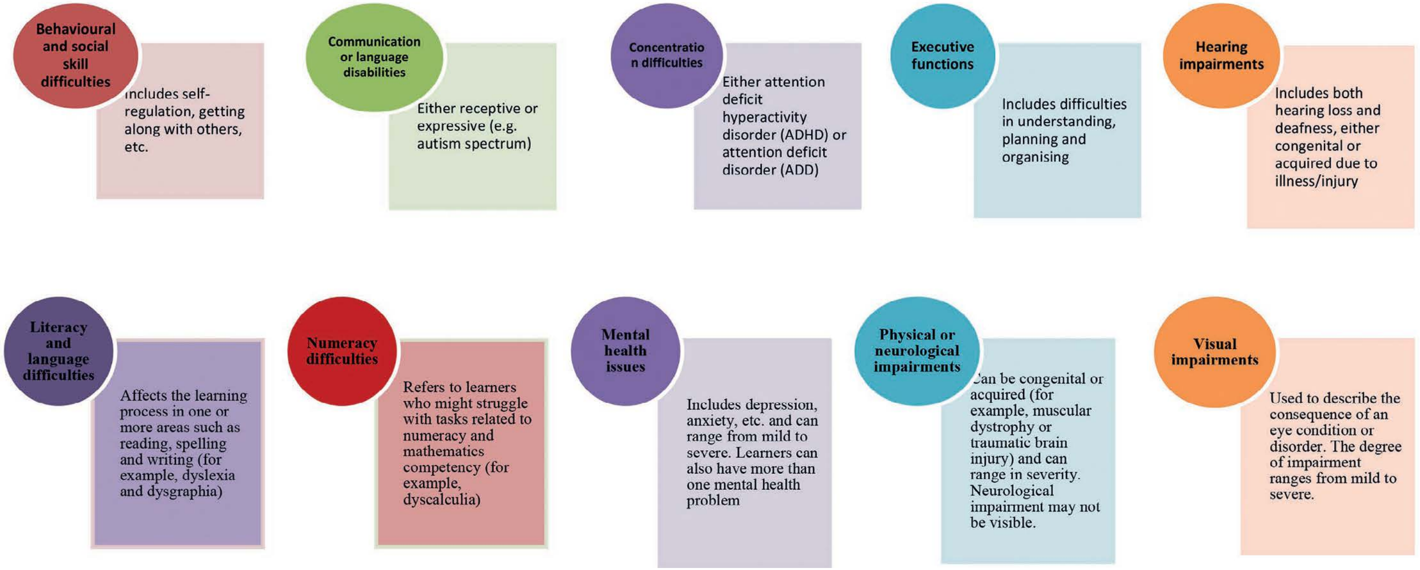

Figure 2. Categories of educational needs
Source: Malbogat, L. (2014). Special educational needs. Cambridge Assessment International Education, IGCSE

Diagnosis of disruptions in development or a disability may not affect education and in such case, no additional support is necessary. On the other side, the experienced development or health difficulties may hinder the process of education when there is no such additional support. Staying in a classroom together with peers, learning in teams may sometimes offer sufficient support, in spite of the fact that it takes place without the teacher's extra support or additional assistance in the form of adjusted teaching strategies. Other students with SEN may need additional didactic support and/ or care and assisting technologies. Irrespective of the child's needs, it is possible to guarantee diversified educational programme and qualified teaching personnel (Griffin, 2014: 21).

In the conducted study, the author assumed that a child with a rare disease and home ventilation experiences limitations in participation in the educational process. This results from current health condition of the child which requires changes in the strategy of teaching and designates educational needs different than the needs of healthy peers. Simultaneously, the author acknowledges the conclusions from studies carried out by Gernsbachear, Raimond Balinghasay, & Boston (2016) which showed that the term "special educational needs" is perceived more negatively by adults (a sample of 530 persons) than the concept of disability. Thus, in the study the author assumed that a child with a rare disease and home ventilation has different educational needs than his/ her healthy peers, yet their character is individual and personalised, but not special. Based on an analysis of literature devoted to the functioning of a child with Spinal Muscular Atrophy with Respiratory Distress Type 1, the author singled out the child's educational needs referring both to pre-school and early school age. They refer to the main symptoms of SMARD1 taking into account, among others, muscle weakness and respiratory distress that require home ventilation and limitations in participation in education outside of home related to it.

Table 1. *Symptoms of Spinal Muscular Atrophy with Respiratory Distress Type 1. Clinical signs and symptoms vs. the child's educational needs*

Spinal Muscular Atrophy with Respiratory Distress Type 1 clinical signs and symptoms	**Educational needs**
weak neck and trunk muscles, difficulties with holding head up	due to greater fatigue, more frequent breaks during work, division of tasks into stages and materials into smaller batches that allow for keeping the level of knowledge taught or the course or the train of thought;
no possibility to change body position, lift arms, turn sideways	preparation of the work place, adjustment of teaching materials and form of tasks and exercises to limited mobility (e.g. a possibility of eye-pointing, preparation of materials that are aimed at expanding experience in the realm of touch, including Newtonian fluid in small containers that can be moved and put close to the child); adaptation of work sheets, school textbooks admitted for school use (e.g. proper positioning of drawings and photographs, specific size of text on a page with larger side margins); taking the individual communication system into account, supporting messages with graphics and gestures during communication in turns;

no head movement which limits the field of vision	presentation of teaching aids, instructions for tasks to be performed within the child's field of vision, most frequently in front of the child and at a proper height; adjustment of the work place: proper positioning of the wheelchair or the child's seat to allow him/ her observe what is going on around him/ her, who is entering and exiting the room, etc.; adaptation of work sheets, school textbooks admitted for school use (e.g. proper positioning of drawings and photographs, specific size of text on a page with larger side margins); taking the individual communication system into account, supporting messages with graphics and gestures during communication in turns;
respiratory distress resulting in mechanical home ventilation	application of the demonstrative method, enabling multi-sensory cognition; combining the content taught with the closest environment of the child's life and education, as well as individual experience which is limited on account of no movement; whilst teaching, taking the individual system of communication into account, e.g. instructions for tasks supported with gestures and graphics; necessity of functional teaching, based on the child's functioning, his/ her activities, engagement, experiences, discoveries and cognition; boosting self-confidence during activities in groups and individual tasks; extension of work time; adjustment of the work place: proper positioning of the child's wheelchair or seat so that he/ she can fully participate in group activities;
no milestones accomplished, i.e. sitting, crawling, walking	combining the teaching content with the closest environment of the child's life and education, as well as individual experiences that are limited on account of lack of mobility; necessity of functional teaching, based on the child's functioning, his/ her activities, engagement, experiences, discoveries and cognition;
elevated pain threshold	the necessity to work out principles pertaining to classes based on tactile experiences, i.e. learning the temperature of water by putting a foot in a container with water;
no verbal speech[a], facial mimicry, possibility of alternative communication	use of devices and techniques designed for communication, preparation of instructions for tasks supported with graphics, pictograms and/ or gestures; application of a broad array of inclusive teaching methods, adjusted to the objectives of the class;

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[a] Some children diagnosed with SMARD1 have verbal speech; however, it is characterised by articulatory disruptions, as well as disrupted (short) pattern of breathing.

auditory hypersensitivity	adjustment of the place of classes (e.g. lining that absorbs noise, classroom located at a distance from places generating noise); limitation of sudden, unexpected sounds from the environment, e.g. bursts of laughter, elevated voice of the teacher, possibility of using muffling headphones, resignation from aids and toys generating high-pitched sounds;
visual hypersensitivity (sunlight, bright lights in the classroom)	adjustment of the place of work by use of lights with a possibility of intensity regulation; limitation of sudden and diverse visual stimuli by, e.g. a cap with a visor, or sunglasses.

Source: Author's own study based on Eckart M., Guenther UP., Idkowiak J., Varon R., Grolle B., Boffi P., Van Maldergem L., Hübner C., Schuelke M., von Au K. (2012). The natural course of infantile spinal muscular atrophy with respiratory distress type 1 (SMARD1). Pediatrics, Vol. 129 (1), pp. 148-56, Kaind A. M., Guenther U. P., Rudnik-Schöneborn S. *at al.* (2008). Spinal Muscular Atrophy with Respiratory Distress Type 1 (SMARD1). Journal of Child Neurology, Vol. 23, No. 2, pp. 199-204, Kamyk-Wawryszuk A. (2019). *Educational needs of preschool children with recognized rare disease and intellectual disability - teachers` perspective*, Journal Plus Education, Vol. XXIV, Special issue, pp. 8-19.

Simultaneously, the above-listed educational needs may be divided into two categories. The first one includes needs related to the child's home ventilation, whereas the second to the diagnosis of a rare disease.

Educational needs related to mechanical ventilation include, among others:

- more frequent breaks during work, division of tasks into stages and materials into smaller batches that allow for keeping the level of knowledge taught or the course or the train of thought due to greater fatigue;
- application of the demonstrative method, enabling multi-sensory cognition;
- combining the teaching content with the closest environment of the child's life and education, as well as individual experiences that are limited on account of lack of movement;
- the need for functional teaching, based on the child's functioning, his/ her activities, engagement, experiences, discoveries and cognition;
- boosting self-confidence of the pre-schooler during activities in groups and individual tasks;
- extension of work time;
- adjustment of the work place: proper positioning of the child's wheelchair or seat so that he/ she can fully participate in group activities.

Educational needs resulting from the diagnosis of a rare disease include:

- individual needs of a child, resulting from high physical fatigue or current treatment process;
- opportunity to participate in activities outside of the classroom (competitions, professions) adapted to the child's physical limitations;
- taking into account the slower pace of work resulting from specific physical limitations;
- planned breaks during didactic classes resulting from the specifics of a child`s treatment and medical-hygiene procedures;

- very close cooperation with specialists during the creation of support programmes;
- supporting active contacts with a child during periods of hospitalisation;
- possibility of interchanging group and individual classes in the periods when the disease worsens;
- possibility of remote teaching during hospitalisation in medical facilities in a foreign country (Kamyk-Wawryszuk 2019).

Study Methods

The study relies on a quality strategy with the use of a case study method, observation techniques, interviews with parents and analysis of the child's medical documentation. The following tools were used during the study:

- sensory sensitivity assessment authored by Bill Nason (Nason 2014);
- author's interview questionnaire with the child's parents pertaining to the level of functioning of the child with home ventilation;
- author's interview questionnaire with the child's parents pertaining to the education of the child in a pre-school age with a rare disease and home ventilation.

The following main research problem was formulated:

- What are the educational needs of a child in a pre-school age with a rare disease and home ventilation?

Along with detailed questions:

- Which educational needs of a child in a pre-school age are related to the diagnosis of a rare disease?
- Which educational needs of a child in a pre-school age are related to home ventilation?
- Which teaching strategies can be applied in pre-school education of a child with a rare disease and home ventilation?

Examined Group

In Poland, there are currently two children diagnosed with SMARD1. The study refers to one of them, due to the fact that the level of functioning of the boys varies and therefore there is no possibility of comparing their educational needs. The differences refer to such areas of development as, for example, speech. The studied boy does not speak and is at the stage when alternative communication is being introduced. On the other hand, the other child uses verbal speech. Therefore, the study procedure encompasses only one child.

Piotr

Pregnancy and Birth

Piotr was born in 2014 with low birth weight (2260 g). Pregnancy progressed correctly and ended with natural birth at full term.

First Disease Symptoms and Diagnosis

At the time of the study, the boy was 6 years' old. After the 7th month of life, he was diagnosed with Spinal Muscular Atrophy with Respiratory Distress Type 1. When he was 2.5 months' old, difficulties with breathing started and the physicians diagnosed symptoms of respiratory distress. He was put on a respirator. Due to this, the boy was hospitalised for 99 days. At the age of 5 months, he underwent a tracheostomy procedure and had a tracheostomy tube inserted permanently (photo No. 1). Three months later, the boy was included in the home ventilation programme. He was initially fed by a probe. At the age of two he underwent the percutaneous endoscopic gastrostomy (PEG). At the age of five, he had an ear drainage procedure.

Photo No. 1 Piotr between 2014 and 2020. Source: private archives.

Psychomotor and Cognitive Development

In his development, Piotr did not accomplish such milestones as sitting, crawling or walking. At the age of three, he was diagnosed with coupled disability of movement and sight. At that time, he could no longer control his body on account of the progressing muscle weakness. However, he is able to move his eyes and make slight movements with the pectoral girdle. Facial mimicry has been preserved. He can sit up with his torso and head propped up. He is not able to change his body position, lift arms or turn his head. At that time, a progressing eye condition was diagnosed. The boy has a limited field of vision which is consequence of the lack of head movement. Limitations resulting from no possibility to move restricted Piotr's capacity to examine the environment and acquire new experiences and skills. The level of cognitive functions was difficult to diagnose at that stage. However, based on conversations with the parents and analysis of opinions issued on the basis of psychological and pedagogical studies conducted at that time, Piotr was not diagnosed with difficulties characteristic for children with intellectual disability. The boy understands instructions and reacts to them with facial expressions. He shows interest in new people. If he wishes to attract attention, he performs an activity that produces sounds or noise, for example he grinds his teeth. With proper tooling that enables positioning, he points to an item or an image that is named and is able to put puzzle pieces together. He recognizes animals, vehicles and toys that he knows and likes on pictures. He makes use of eye-pointing. He gets bored quickly. He chooses persons with whom he wants to work. Given the vision defect (astigmatism, squint), Piotr experiences problems with eyeball coordination.

Sensory Processing

The boy manifests behaviour related to auditory hypersensitivity. He is sensitive to loud and sudden sounds, for example when someone laughs out loud. Noisy activities or classes make him isolate from the environment. It can be noticed that he is pressing his eyelids shut. He does not like songs for children. Sometimes, he ignores sounds from the environment that annoy him. He manifests tactile hypersensitivity in the orofacial sphere. He does not tolerate logopaedic massage or its elements. Piotr does not like to be touched on his face, but he tolerates and likes hygiene activities. He feels uncomfortable when his clothes are too tight or when he is massaged with sensory balls with spikes. He cools down quickly. Piotr has an elevated pain threshold. Within the realm of proprioception, he has a weak muscle tone, which results from the specific nature of the disease. In the realm of sight, he is hypersensitive to sunlight and bright light. He often squints. He is not overwhelmed with significant changes in the appearance of persons or people. He maintains eye contact.

Self-service

The boy does not perform self-service activities. On account of swallowing difficulties, he is fed via percutaneous endoscopic gastrostomy (PEG). He does not signal physiological needs and wears diaper. From time to time, he signals discomfort related to the experiencing of physiological needs. At the age of three, Piotr was diagnosed with un-integrated bite reflex, excessive salivation resulting from reduced muscle tone in the area of the oral cavity. Before turning one, he tried new flavours, but he frequently spat the food out. He pressed his lips on a spoon. This was the stage when he was fed by a tube (Photo No. 2).

Photo No. 2 Feeding Piotr, 2014. Source: private archives.

Speech and Communication

Piotr babbled after turning one. However, no verbal speech has developed. Lack of independent breathing contributed to the lack of vocalisation. In spite of it, the boy is able to whisper the word “mama”. Nevertheless, mimicry that is used for communication is limited. Piotr cries silently, only his tears are visible. Reduced efficiency of the articulation apparatus is noticeable on account of muscle paresis manifested with reduced tension in the area of the oral cavity. At the age of three, Piotr could slightly press his lips and make them vibrate. No purposeful movements of the tongue, high vaulted palate, malocclusion. Additionally, there was increased mobility of the mandible and a tendency for mesio-occlusion.

In the area of pre-verbal communication, on the level of primary communication (contact with the environment on the level of own body perception), he is able to express impressions of own body in a specific mode. When he is uncomfortable at night and wants to change his body position or when he wants to sit up, he shows it with facial mimicry or makes “prrr” sounds. Piotr reacts in a specific manner to individual selected stimuli from the environment, for example he follows a person with his eyes. On the level of sensory communication (contact with the environment via gestures and specific types of behaviour, e.g. screaming, hitting objects, laughter), Piotr reacts to voice: he is actively searching for the source of voice by smiling and trying to look in that direction; he initiates and maintains eye contact. When he is excited, for example, after the grandfather’s visit, he moves his shoulders. Within the realm of communication on the level of behaviour, Piotr reacts to his name and to verbal communications from the environment (e.g. referring to daily, repetitive rituals, for example the story read at bedtime by his dad, watching cartoons in the morning). He initiates contact with other people in a manner enabled by his health condition, e.g. by looking at a specific person. He enjoys company. When he does not want to do something or when a given activity makes him uncomfortable, he shuts his eyes (Photo No. 3).

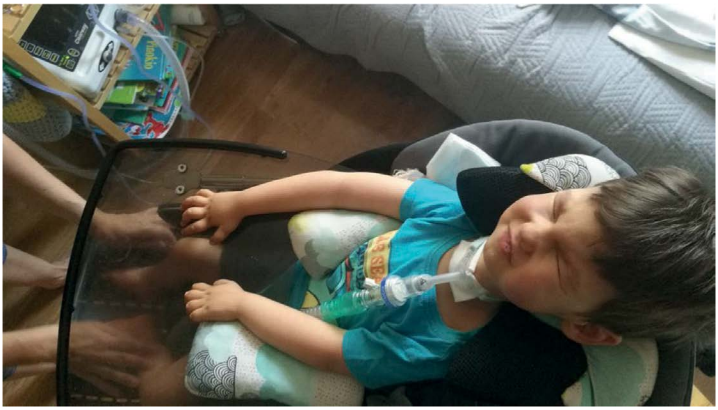

Photo No. 3 "No" communication Source: private archives.

The first attempts at introducing alternative communication were made in 2015; they relied on introduction of the switch tool and exercising the ability of eye-pointing to items.

Educational Needs of a Child with Rare Disease and Home Ventilation: Results of Own Studies

Based on the analysis of literature devoted to the functioning of a child with SMARD1, the author has prepared a list of educational needs. It includes two groups of needs. The first is related to the diagnosis of a rare disease, the second to the respiratory distress resulting in mechanical home ventilation. Based on study results, it may be concluded that in the first group, four needs were not present in the case of the child in question (Table 2 and 3). This is related to, among others, Piotr's health condition and no approved treatment procedure for SMARD1. At the present moment, clinical trials are under way (Centro Clinico Nemo in Milan), yet in Poland there is no procedure to apply and no principles and guidelines to be followed with respect to the treatment process. This situation resulted in the child's exclusion from hospitalisation in specialist medical centres located, among others, in Italy. Therefore, the needs listed in the catalogue that result from diagnosis of a rare disease are primarily related to the limitations that are a consequence of the weak muscle tone, characteristic for SMARD1, and not experimental treatment.

Table 2. *Piotr's educational needs related to diagnosis of a rare disease*

Educational needs	
related to the rare disease diagnosis	**presence of a need**
individual needs of a child, resulting from high physical fatigue or current treatment process,	YES
opportunity to participate in activities outside of the classroom (competitions, professions) adapted to the child's physical limitations,	YES
taking into account the slower pace of work resulting from specific physical limitations,	YES
planned breaks during didactic classes resulting from the specifics of a child`s treatment and medical-hygiene procedures,	NO
supporting active contacts with a child during periods of hospitalisation,	NO*
very close cooperation with specialists during the creation of support programmes,	YES
possibility of remote teaching during hospitalisation in medical facilities in a foreign country,	NO
possibility of changing the form of classes: interchanging individual and group classes in the periods when the disease worsens.	NO

*Piotr's current health condition does not require extended periods of hospitalisation. Source: author's own study.

Within the scope of educational needs related to the respiratory distress and the necessity of using a respirator, based on the performed study it is possible to indicate that all of the needs listed in the catalogue were present.

Table 3. *Piotr's educational needs related to mechanical home ventilation*

Educational needs	
related to mechanical home ventilation	**presence of a need**
due to greater fatigue, more frequent breaks during work, division of tasks into stages and materials into smaller batches that allow for keeping the level of knowledge taught or the course or the train of thought,	YES
application of the demonstrative method, enabling multi-sensory cognition,	YES
combining the teaching content with the closest environment of the child's life and education, as well as individual experiences that are limited on account of lack of movement,	YES
the need for functional teaching, based on the child's functioning, his/ her activities, engagement, experiences, discoveries and cognition,	YES
boosting self-confidence of the pre-schooler during activities in groups and individual tasks,	YES
extension of work time,	YES
adjustment of the work place: proper positioning of the child's wheelchair or seat so that he/ she can fully participate in group activities.	YES

Source: author's own study.

CONCLUSION

Determination of educational needs allows for personalisation of the teaching strategy. This is indispensable for making sure that both a pre-schooler and a school student master the curriculum and acquire new information and skills. In the modern times, limitations resulting from dependence on medical equipment, such as a respirator, hinder, but do not deprive of the possibility of self-fulfilment in the role of a pre-schooler or a student or, in the future, a qualified employee (e.g. remote work from home with adjusted assisting technology). Resources of persons permanently using medical equipment are still unmanaged, thus it is important to tackle the issues of education of children using such equipment in studies.

Based on the performed study it may be concluded that in the case of a pre-schooler with a rare disease and home ventilation, four out of eight educational needs resulting from a rare disease and all needs related to the respiratory distress and home ventilation were present. Thus, the catalogue of educational needs will comprise the following needs:

- individual needs of a child, resulting from high physical fatigue or current treatment process,
- opportunity to participate in activities outside of the classroom (competitions, professions) adapted to the child's physical limitations,
- taking into account the slower pace of work resulting from specific physical limitations,
- very close cooperation with specialists during the creation of support programs,
- more frequent breaks during work, division of tasks into stages and materials into smaller batches that allow for keeping the level of knowledge taught or the course or the train of thought,
- application of the demonstrative method, enabling multi-sensory cognition,
- combining the teaching content with the closest environment of the child's life and education, as well as individual experiences that are limited on account of lack of movement,
- necessity of functional teaching, based on the child's functioning, his/ her activities, engagement, experiences, discoveries and cognition,
- boosting self-confidence of the pre-schooler during activities in groups and individual tasks,
- extension of work time,
- adjustment of the work place: proper positioning of the child's wheelchair or seat so that he/ she can fully participate in group activities.

This shows that whilst designing education for such child, it is necessary to take into account needs related to the use of medical equipment, as well as to select such an educational path that incorporates the possibilities of professional functioning based on remote work and assisting technology. Technological progress, both in medicine and in tooling for people with motor disabilities is going to change in the next 20 years, allowing these students and in the future adult people to have greater participation in both social and professional life.

The conducted study allows for one more conclusion. It is not directly related to the study objective, but equally important. It is necessary to set up a research network that is going to tackle the issues of pre-school and school education in its projects, including support and adjustment of teaching strategies for persons dependant on medical equipment, e.g. children with mechanical ventilation and forging their potential into self-fulfilment/ independence both in the professional and social aspect.

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FACTORS RELEVANT TO SOCIAL PARTICIPATION IN PRIMARY SCHOOL STUDENTS WITH CEREBRAL PALSY IN THE REPUBLIC OF SERBIA[a]

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SUMMARY

The main aim of this paper is to identify factors that could determine social participation of pupils with cerebral palsy in elementary schools in the Republic of Serbia. Social participation is within this paper viewed from the perspective of independent execution of non-academic school activities that the pupils with cerebral palsy perform daily in the school environment, which they need in order to be able to fulfil the academic tasks.

The study included 75 pupils with cerebral palsy, 6 to 12 years old, who attended mainstream elementary schools and schools for students with special educational needs from the first to the sixth grade. In order to assess their participation in the school environment, the third part of the SFA (The School Function Assessment) questionnaire were used. The extent of impairment of pupils' gross motor and manual ability was assessed by the GMFCS (Gross Motors Classification System) and MACS (Manual Ability Classification System) scales. As independent variables, we have determined 9 individual factors that relate to the characteristics of pupils with cerebral palsy, and 1 environmental factor that relates to the type of school the students attend.

The results indicate the importance of motor skills and intellectual and writing abilities of pupils with cerebral palsy as significant predictors of social participation in school environment in the Republic of Serbia.

Key words: Cerebral palsy, social participation, school function assessment, primary school

INTRODUCTION

Cerebral palsy (hereinafter referred to as CP) is a group of movement and postural disorders that occur damage due to non-progressive brain at an early developmental period. Limiting motor activities from an early age almost always results in a decrease in early sensory motor experiences. Accordingly, these children often do not have the opportunity to develop their cognitive skills, social skills, and consequently, independence in everyday situations, satisfying their needs and interests fully as children without limitations. In addition, primary motor impairment is most commonly accompanied by associated disorders such as sensory and intellectual impairment, speech and language impairment, the presence of epilepsy, and secondary musculoskeletal and psycho-emotional problems, which further complicates the

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[a] This research was done as part of the doctoral dissertation. Zulić, M. (2018). *Predictors of Social Participation of Children with Cerebral Palsy in Primary Schools in the Czech Republic and Republic of Serbia.* Faculty of Education, Charles University, Prague, Czech Republic.

functionality of these individuals (Zulic, 2018). Given the heterogeneity of this condition with a wide spectrum of disorders, the question is, how the consequences of this impairment affect the participation of persons with CP in different life situations.

According to Nedović, Rapaić, Odović, Potić and Milićević (2012), participation in everyday, school and leisure activities is the basis for development of social skills and a social support network for each child, while the inclusion of lower quality and less frequent activities can negatively affect the forming of social relationships and reducing the quality of its life. Also, King et al., (2003) emphasized that if individuals are not given the opportunity to participate in a range of different activities, then they are actually denied the opportunity to fulfill their potential as active participants in community life.

School is a place where the pupil develops and creates social contacts, acquires not only school habits but also practical skills as preparation for the next phase of life. Considering the fact that it is established that the participation of pupils with CP is an important indicator of their successful social participation in adolescence and adulthood (Mei et al., 2012), it is necessary to estimate the factors that influence their participation in school age. Therefore, the choice of school environment for examining the social participation of pupils with CP is of great importance for identifying their potential obstacles in future life.

The main objective of this paper is to determine the predictors of social participation, i.e. the factors which could determine, in advance, the intensity of social participation of pupils with CP in the primary schools established specifically for the pupils with special educational needs and the regular primary schools in the Republic of Serbia. The unique characteristic of this study is finding out the participation of the these pupils in six different school situations: in the classrooms, in the corridors and hallways between the classrooms, at the school playground, on their way to and from the school, when using the sanitary facilities, and in the school canteen. Each of the situations observed requires a certain level of function abilities to fulfil the demands they bring in an adequate manner. According to the information available, this is the first study which identifies the predictors of social participation of pupils with CP in schools in the Republic of Serbia using the School Function Assessment (SFA) questionnaire. The results of this study may help to detect important factors which support the effective participation of the pupils with CP in schools and thereby enable appropriate support measures for the purpose of their successful education, as well as the establishment of a more stable basis for their active social participation in adulthood.

Basic concepts

Social participation

Social participation represents an interaction between an individual and the physical, social and attitudinal environments (Colver, 2006, 2015). According to the international classification of functioning, disability and health, social participation is defined as taking part in a life situation or life experience in relation to the level on which the person actively participates and not in relation to how much the person can or wants to participate (WHO, 2010). Being able to participate fully in society is particularly important for children to ensure their successful transition to adulthood and, ultimately, their independent living (Parkes et al., 2010). Through social participation, children form friendships, gain knowledge, learn skills, develop their own creativity and develop notions of the importance and meaning of life (Dijkers et al., 2002). Also, while participation in social learning situations stimulates cognitive development, lack of opportunities to participate may slow down cognitive development (Bottcher, 2010). Participation of children with disabilities in special education is a necessary prerequisite for the fulfillment of inclusive education and is also the goal of educational and support activities and measures (Pancocha, 2013).

A large number of studies throughout the world proves that the social participation in environment outside the family is of key importance for children with physical disability (Lepeage, 1998; McGavin, 1998). According to these researches the most common issues affecting the social integration of the children and adolescents with CP are reported in the functioning at school with the statistically significant relation to the level of the motor disorder of the individual (Schenker et al., 2005; Voorman et al., 2006). Participation is an important outcome measure, which should be considered when planning services targeting children and adolescents with CP (Longo et al., 2012).

Cerebral palsy

The term cerebral palsy (CP) includes a wide range of brain disorders resulting in the reduced value of motor function and a number of associated damages. According to Rosenbaum at al. (2007), CP encompasses a heterogeneous group of early-onset, non-progressive, neuromotor disorders that affect development of the fetal or infant brain. There are many definitions of the CP, in accordance with a variety of approaches to the large number of experts in this field, but the authors consider that the definition of the Executive Committee of the American Association for CP and Developmental Neurology (AACPDM), is the most comprehensive and most objective, therefore we will state it. “CP is a group of permanent disorders of the movement and body posture development bringing the limitation of activity caused by non-progressive damage to the brain in fetal and/or infant development” (Bax et al., 2005). Even though, according to the definition, CP is caused by non-progressive damage to the brain, there is a wide range and varying extents of lesions incurred. Motor disorders in CP are very often related to the sensory disorders, perception disorders, and disorders of cognition, communication, attention and behaviour as well as to the epilepsy and secondary muscular and skeletal disorders (Bottcher, 2010). The most serious and distinct problems of the children with CP affect motor skills, cognitive skills and speech. Through each of these areas, the child with CP establishes contact with closer and broader social environment in the manner determined by the nature of the brain damage (Rapaić & Nedović, 2011).

The common data on the occurrence of CP worldwide oscillates between 1,7 and 2,1 per one thousand of children born alive (Zoban, 2011). According to other authors, the prevalence in the world is two to five children with CP per one thousand of children born alive (Kraus et al, 2005). Due to the technical improvements of intensive care and the constant technological innovation in the field of medicine, an increasing number of premature infants with very low birth weight survive the earliest period of life which, with the prolonged life span of the general population, leads to an increased number of adults with severe and multiple forms of disability, including CP (Milićević & Potić, 2012).

In addition to CP being a very complex medical problem, it becomes an educational problem in school age children and social problem in adolescence, as well. The issues of CP therefore extend to the family and subsequently social environment (Rapaić & Nedović, 2011). From these data it is clear the number of people with CP in the world is not marginal and that this issue deserves special attention of all relevant scientific fields.

Determinants of social participation of children with CP

Numerous researches show that children with CP experience certain limitations in social and personal life. Usually are stated the individual and environmental factors as the limiting elements in their proper social participation. Number of studies report individual characteristics of children with CP as the most important determinants of their social participation: severity of the disability, level of motor ability, intellectual status, manual skills, speech abilities, age, presence of pain, epilepsy, psychological problems, etc. (Beckung & Hagberg, 2002; Kerr et al., 2007; Law et al., 2004; Østensjø et al., 2003). Some studies favour environmental factors, or factors from the narrower or wider environment, which affect the social participation of these children, whether physical, political or institutional. These include, in particular: individual and institutional attitudes, architectural barriers, accessibility of transport, family support, place of residence and socio-economic possibilities of the surroundings (Forsyth et al., 2007; Hammal et al., 2004; Michelsen et al., 2009; Welsh et al., 2006).

Voorman et al., (2006) researched the level of functional activities and level of social participation of 110 pupils with CP aged 9-13 years in the following areas: movement, personal care, housing, social life and communication. Subsequently, they analysed the links between the activity and the participation and personal features and characteristics of the CP as the condition. The results obtained proved a high level of statistical interrelation between the finding of the evaluated gross motor functions (according to GMFCS scale) and evaluated participation in the areas of movement, personal care and housing. The presence of cognitive damage and type of CP are statistically interrelated with the success in the areas of personal care and housing while the presence of the cognitive damage and epilepsy are the most significant factors affecting social participation in the areas of social life and communication.

Ghaffari with the research team (2020) evaluated the intensity of leisure participation of 232 children with CP, aged 6 to 14 years and their parents, from four Iranian schools of children with special educational needs and five rehabilitation centres. They state that the intensity of CP children's participation in activities is influenced by child, family and environmental factors. The active participation of parents in children's leisure and recreational activities provide children more opportunities to participate. Higher gross motor function, manual ability, and communication function also play an important role in their participation.

According to the five-year longitudinal study performed with the participation of 594 children (aged 8-12 years) (later adolescents aged 13 – 17 years) with CP in Europe, it was discovered that social participation in childhood is the main predictor of participation during adolescence. Three factors in childhood which occur most frequent in the families who have children with CP are as follows: pain, mental problems and stress of the parents in different stages may result in limited social participation of the adolescents (Mo Dang et al., 2015).

Based on the researches above, we can clearly see that children with CP are at huge risk for experiencing limitations in their personal and social life.

Participation of children with disabilities in the school environment

For the integration of children with MO into the school environment, it is of great importance that the educational process corresponds to the child's abilities, both in terms of content and conditions adapted to its limitations and in terms of achieving other abilities needed for its physical, mental and social development. Experts also emphasize that good school results depend to a large extent on the level of the pupil's ability to perform everyday activities which allow the pupil to take part in all of the activities during the school day (Coster & Haley, 1992). These functional activities relate to non-academic aspects of the school program and differ significantly from the academic activities. The academic activities mean elaboration of school work and homework which reflect the level of mastering the school program and whose primary objective is to enhance knowledge in the respective areas, i.e.: language, mathematics, artistic subjects and science. Compliance with the school program entails mastering all of the basic functional skills including the handling of books and pens, fulfilling the instructions for the preparation of the learning material, finding the information or assistance, movement in the classroom and school, satisfaction of personal needs in an adequate manner and interaction with classmates during the classes. These activities are the non-academic ones. Pupils with developmental disorders often experience difficulties in fulfilling the assigned expectations due to their physical or cognitive limitations.

Schenker et al., (2005), in their research of 148 pupils with CP aged 6-13 years, found that there are significant differences in the levels of participation and functional activities (physical and cognitive-behavioural) according to the type of CP and level of movement preservation (SFA - part 1 and part 3, and GMFCS). The levels of participation and performance of activities are lower if there is a higher level of movement damage and/or if there are additional neurological damages.

A study from the Czech Republic (Zulic et al., 2018) which refers to the social participation of 75 students with CP using SFA instrument, showed that the participation of these pupils in the school environment depends primarily on the level of gross motor functions (estimated with GMFCS) and intellectual abilities of students, than on their speech and writing abilities and on the one selected environmental factor - the type of school the pupils attend.

All the facts stated in the studies mentioned above refer to the fact, that the participation in everyday, school and extracurricular activities is the basis for the development of social skills and network of social support of each child while the involvement in activities with lower quality and frequency may negatively affect the establishment of social relationships and quality of life.

Legislation in the education system of students with special educational needs (SEN) in the Republic of Serbia

The document “The Salamanca Statement and Framework for Action on Special Needs Education” (UNESCO, 1994) set out the principles of education for all, and were integrated into the legal framework of education in Serbia. According to Serbian law, primary education is compulsory, which also applies to children diagnosed with CP. A pupil with CP can attend a regular primary school, a school for pupils with SEN or a special class of a regular primary school (Službeni glasnik RS, 2017). By law, every pupil should attend classes at a mainstream school, unless the parent / legal representative states otherwise. In this case, the child can attend a school for children with SEN. Each pupil should be provided with an education in accordance with their abilities, possibilities and interests, either in the regular educational program of the school or according to an individual educational plan (IEP). The undeniable advantage that pupils with CP in Serbia have, is the legislative ensuring of their right to study at school as close as possible to their place of residence (in the catchment school) in a group of classmates without disabilities (Hajkova & Zulic, 2015). This attitude determines the need for counselling services available to the school (Nišević & Ilić-Stošović, 2013).

One of the most important institutions of the education system in Serbia is the Interdepartmental Commission (IDC) (Interresorna komisija) whose work is based on the approved Law on the Foundations of the Education System (Službeni glasnik RS, 2018). The basic task or authority of the IDC is to assess the child’s needs for additional educational, medical or social support. Additional support covers rights and services that ensure to the child overcomes the physical and social obstacles to the unrestricted performance of daily life activities that are important for participation in the educational process, life in society and its development (Službeni glasnik RS, 2018). The IDC provides an assessment of needs and barriers as well as specific solutions to overcome them, with the task of identifying and recommending various types of additional support, including monitoring and evaluation the implementation of the proposed support. Additional support of student is provided by one of three levels of support based on the pupil’s pedagogical profile and defined priorities and needs. Support measures were provided free of charge by schools and interdepartmental commissions.

METHOD

The aim of the research

The main objective of this paper is to determine the predictors of social participation, of pupils with CP in primary schools in the Republic of Serbia. Participation is analysed on the basis of independent execution of 21 school non-academic activities in six different school situations and environments. Selected predictors used for the research were considered based on previous research findings, indicated above (chapter II). Potential predictors are nine individual factors that represent the characteristics of each subject (gross motor functions, manual and intellectual abilities, age, gender, visual status, presence of epilepsy, handwriting and possibility of expressive speech) and one environmental factor (the type of school the student attends). Considering the fact that no one predictor can perform isolated, but in the combination with at least another one or more of them (Zulic, 2018), we accessed data processing using regression (multiple) analysis.

Participants

The sample (N = 75) consisted of 35 children from regular primary schools and 40 from schools for pupils with SEN with the diagnosis of CP. The students were from six to 12 years old (with a mean of 9.43 years), from the first to the sixth grade. Over 60% of the respondents were male (n=46), while 29 were female. Students included in this study were attending public primary schools in eight regions across Republic of Serbia. Due to the researched areas of social participation which are the part of the everyday school life and whose performance and training requires certain cognitive structure of the subject, only respondents with an IQ higher than 35 were considered (WHO 2010). Given that all participants have been diagnosed with CP, their motor function was tested by GMFCS assessment, and manual abilities were estimated by MACS scale as discussed below (Table 1).

Table 1. *Socio–demographic data and distribution of respondents with CP according to individual functional characteristics*

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Age of respondents					
Age	6–7	8	10.6	10.6	10.6
	7–8	11	14.7	14.7	25.3
	8–9	9	12.0	12.0	37.3
	9–10	15	20.0	20.0	57.3
	10–11	11	14.7	14.7	72.0
	11–12	21	28.0	28.0	100.0
	Total	75	100.0	100.0	
Gender structure of respondents					
Gender	male	46	61.3	61.3	61.3
	female	29	38.7	38.7	100.0
	Total	75	100.0	100.0	
Number of respondents in regular schools and in schools for pupils with SEN					
School	1.00	35	46.7	46.7	46.7
	2.00	40	53.3	53.3	100.0
	Total	75	100.0	100.0	

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
Number of respondents by grades					
Grade	1.00	7	9.3	9.3	9.3
	2.00	19	25.3	25.3	34.7
	3.00	6	8.0	8.0	42.7
	4.00	11	14.7	14.7	57.3
	5.00	12	16.0	16.0	73.3
	6.00	20	26.7	26.7	100.0
	Total	75	100.0	100.0	
Number of respondents by regions in Serbia					
Regions	1.00	8	10.7	10.7	10.7
	2.00	45	60.0	60.0	70.7
	3.00	17	22.7	22.7	93.3
	4.00	5	6.7	6.7	100.0
	Total	75	100.0	100.0	
Intellectual status of respondents					
Intel. status	1.00	53	29.3	29.3	29.3
	2.00	22	70.7	70.7	100.0
	Total	75	100.0	100.0	
Speech (expressive) of respondents					
Speech	1.00	10	13.3	13.3	13.3
	2.00	65	86.7	86.7	100.0
	Total	75	100.0	100.0	
Handwriting of respondents					
Writing	1.00	50	66.7	66.7	66.7
	2.00	25	33.3	33.3	100.0
	Total	75	100.0	100.0	
Visual impairment of participants					
Visual status	1.00	16	21.3	21.3	21.3
	2.00	59	78.7	78.7	100.0
	Total	75	100.0	100.0	
Presence of epilepsy					
Epilepsy	1.00	16	21.3	21.3	21.3
	2.00	59	78.7	78.7	100.0
	Total	75	100.0	100.0	
GMFC – gross motor status of respondents					
GMFCS	1.00	11	14.7	14.7	14.7
	2.00	20	26.7	26.7	41.3
	3.00	17	22.7	22.7	64.0
	4.00	21	28.0	28.0	92.0
	5.00	6	8.0	8.0	100.0
	Total	75	100.0	100.0	

		Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
MACS – manual abilities of respondents					
MACS	1.00	9	12.0	12.0	12.0
	2.00	20	26.7	26.7	38.7
	3.00	22	29.3	29.3	68.0
	4.00	19	25.3	25.3	93.3
	5.00	5	6.7	6.7	100.0
	Total	75	100.0	100.0	

School: 1.00 - regular school, 2.00 school for pupils with special educational needs (SEN)
Grades: 1.00 - first grade, 2.00 - second grade, 3.00 - third grade, 4.00 - fourth grade, 5.00 - fifth grade, 6.00 - sixth grade
Areas of the state: 1.00 - Belgrade; 2.00 - Vojvodina; 3.00 - Sumadija and western Serbia; 4.00 - Southern and eastern Serbia (RZS, 2018)
Intellectual status: 1.00 - with disturbances; 2.00 - without disturbances
Speech (expressive) of respondents: 1.00 - with disturbances; 2.00 - without disturbances
Handwriting of respondents: 1.00 – write; 2.00 – don´t write
Visual impairment of participants: 1.00 – with disturbances; 2.00 – without disturbances
Presence of epilepsy: 1.00 – with presence of epilepsy; 2.00 – without presence of epilepsy
GMFCS: from the first to the fifth grade
MACS: from the first to the fifth grade

Instruments

a) SFA - The School Function Assessment: Original version of SFA (from publisher Pearson; Coster et al., 1998) was adapted through translation from English to Serbian and backward translation from Serbian to English. According to the analysis of the validity of the questionnaire, all subscales of social participation show good reliability in a sample of this research. This questionnaire was prepared to evaluate and measure the performance of respective function activities which are the base for the participation in the academic and social aspects on the level of the primary schools' programme and thus to allow the experts an insight into the abilities of pupils with various forms and levels of abilities and consequently preparation of individual educational programmes. The questionnaire consists of three units which may be used as separate, independent scales as well. Our research determined the joint participation of each pupil separately by summarizing the participations measured in six different environments – situations: (1) participation during the class at regular school or school for pupils with SEN, (2) at the school playground or during the school breaks, (3) transport to and from school, (4) use of sanitary facilities, (5) movement between the classes and (6) behaviour in the school canteen during lunchtime or snack.

In this paper we present the results obtained using the third part of the questionnaire SFA which concerns the quality of the performance of the pupil's activity. The third part of the SFA questionnaire names Activity performance is divided into two parts: a physical part which includes 12 separate activities in respect of the participation in the physical sense, and a cognitive and behavioural part which includes nine prepared cognitive and behavioural activities. Each of the tasks has a number of specific questions or claims that are intended to answer by selecting one out of four prepared numerical answers ranked upwardly according to the participation level (answer 1 - student does not perform the activity, answer 4 - student consistently performs the activity). Data collection with the use of the SFA questionnaire is not based on the answers provided directly by the pupils. The research expects that the teachers (pedagogues, pedagogical assistants, special educators...) working with the students have sufficient knowledge to provide information on the function of the pupils in the school environment. The table below shows the tested areas of social participation based on the SFA questionnaire (Table 2).

Table 2. *Tested areas of social participations of pupils with CP in primary schools*

Part III-Activity Performance	
Physical Tasks	**Cognitive/Behavioural Tasks**
Travel	Functional Communication
Maintaining and Changing Positions	Memory and Understanding
Recreational Movement	Following Social Conventions
Manipulation with Movement	Compliance with Adult Directives and School Rules
Using Materials	Task Behaviour/Completion
Setup and clean up	Positive Interaction
Eating and Drinking	Behavioural Regulation
Hygiene	Personal Care Awareness
Clothing Management	Safety
Up/Down Stairs	
Written Work	
Computer and Equipment Use	

b) GMFCS - The Gross Motor Function Classification System: The GMFCS is a scheme designed for children and adolescents with diagnosed CP aged 18 and younger (Palisano et al., 2007). The classification is made based on five levels of current performance of gross motor function in daily activities with emphasis on mobility and sitting, ranging from level I (most able) to level V (least able). According to Palisano et al., (2000) and Wood and Rosenbaum (2000), the GMFCS has evidence of content construct and discriminative validity and inter-rater reliability as well as the reliability of the evaluation. The original English version of the GMFCS questionnaire is now available in 24 different languages, including Serbian.

c) The Manual Ability Classification System (MACS) describes the way of handling objects in children and adolescents with CP, aged four to 18 years in activities of everyday life (Eliasson et al., 2006). It was created as the equivalent of the GMFCS classification to emphasize the importance of manual skills for reaching independence in everyday life. This scale contains five levels, which are based on the child's ability to handle objects and the need for help or adaptation while performing manual activities. Grade I refers to children with minor limitations of manual ability, while children with more severe functional limitations belong to IV and V degree. This is about handling items that are adequate to the child's age and that are used in eating, dressing, playing, drawing or writing. This tool has been translated from English into 27 languages, including Serbian.

Procedure

The research was performed in the primary schools in the Republic of Serbia during 2017 and 2018 across the four regions of the state: Belgrade, Vojvodina, Šumadija and western Serbia and Southern and eastern Serbia (RZS, 2018). Data of students with CP were collected by the first author and research team. Each session took about two hours. The socio-demographic data (name, surname, age, place of stay, information concerning the education) were collected by the socio-demographic part of the questionnaire, reported by the teacher or psychologist and using basic school data. The answers to the SFA questionnaire were provide by the teachers, school psychologists, special education teachers, pedagogical assistants and other people working with the pupil in the school environment and well familiar with the pupil. The data collection was conditioned by the approval to perform the research from the legal representative of the child (pupil) and the management of the school in which the research is to be performed. The legal representatives, school principals and teachers (participating in the research) were informed of the characteristics and objectives of the research and handling of the data collected.

Statisical Analysis

Data analysis was performed in SPSS 21. The Cronbach reliability coefficient (Cronbach's alpha) was used to check the reliability of the tool SFA. The factor analysis check was performed in order to confirm the expected structure of the questionnaire. For statistical processing of this study were used T-test for independent samples, Pearson's correlation coefficient and the Mann-Whitney as a non-parametric substitution (in the case of less than 20 respondents in each group). To identify the common value of predictive variables and their individual value, multiple regression analysis was performed for each area of social participation (Hendl, 2012).

RESULTS

In order to show the effect of the selected predictors on the social participation of students with CP in the school environment, and taking into account their mutual influence, we conducted a regression analysis of all the predictors by performing physical and cognitive - behavioural activities. This analysis refers to the combined effect of the predictors set, as well as their individual contribution to the performance of these activities and provides conclusions regarding the full participation of students with CP in the school environment. The analysis was conducted separately for each area of social participation. The set of monitored predictors is statistically important for all evaluated areas and explains from 31 to 82 % of the variance (R2 column in the Table 3).

Table 3. *Predictors of performing all school functional tasks by pupils with CP*

PARTICIPATON III	**gender**	**type of the school**	**age**	**intellect. status**	**speech**	**handwriting**	**visual status**	**epilepsy**	**GMFCS**	**MACS**	**F**	**R**	**R^2**	**P**
Travel	0.006	0.098	0.124	0.015	0.065	0.014	**0.156****	0.001	**-0.675****	**-0.191***	17.534	0.868	0.754	0.00
Maintaining and Changing Positions	0.033	0.008	0.102	-0.044	-0.017	-0.110	-0.124	-0.091	**-0.845****	-0.055	27.608	0.910	0.828	0.00
Recreational Movement	-0.005	0.030	0.044	-0.078	-0.084	0.016	0.056	-0.055	**-0.746****	-0.071	10.49	0.804	0.647	0.00
Manipulation with Movement	-0.078	0.118	0.078	-0.048	-0.026	-0.029	0.061	-0.044	**-0.617****	**0.274****	15.07	0.851	0.725	0.00
Using Materials	-0.048	0.044	0.085	-0.090	-0.086	**0.229****	0.081	-0.121	-0.135	**-0.613****	14.76	0.849	0.720	0.00
Setup and clean up	-0.055	0.153	0.020	0.066	-0.053	0.034	0.042	-0.136	**-0.429****	**-0.450****	12.97	0.833	0.694	0.00
Eating and Drinking	0.095	0.049	0.049	-0.001	-0.013	0.093	0.096	**-0.207***	-0.174	**0.522****	7.51	0.753	0.492	0.00
Hygiene	0.032	0.024	0.109	-0.027	0.092	-0.011	0.024	-0.145	**-0.354****	**-0.465****	10.245	0.801	0.641	0.00
Clothing Management	-.0055	0.000	0.107	-0.053	-0.053	0.020	0.109	-0.030	**-0.600****	**-0.322****	23.242	0.896	0.802	0.00
Up/Down Stairs	0.017	-.0067	0.107	0.023	0.025	-0.083	-0.063	-0.074	**-0.765****	-0.164	21.803	0.890	0.792	0.00
Written Work	-0.049	-0.054	**0.255****	-0.141	-0.029	**0.493****	0.115	-0.067	-0.055	**-0.358****	12.492	0.826	0.686	0.00
Computer and Equipment Use	**-0.225***	-.0015	0.182	**-0.283***	0.046	**0.235***	0.060	-0.190	-0.098	-0.132	4.07	0.645	0.415	0.00
Functional Communication	-0.044	0.029	0.065	**-0.323***	**0.318****	0.074	0.005	**-0.258***	**0.299***	**0-.316***	4.65	0.67	0.448	0.00
Memory and Understanding	-0.110	0.099	-0.007	**-0.371****	0.042	**0.211***	-0.058	**-0.399****	**0.261***	**-0.322***	6.092	0.718	0.515	0.00
Following Social Conventions	-0.051	-0.004	0.165	**-0.319***	**0.221***	**0.210***	-0.078	**-0.212***	**0.345****	**-0.353***	5.25	0.69	0.478	0.00
Compliance with Adult Directives and School Rules	-0.044	0.071	0.190	**-0.325***	0.123	0.138	-0.151	**-0.208***	0.025	**-0.366***	4.38	0.66	0.433	0.00
Task Behaviour/Completion	-0.137	0.093	0.110	**-0.526****	0.002	**0.321****	-0.014	-0.091	0.239	-0.169	4.71	0.67	0.451	0.00
Positive Interaction	-0.028	0.068	0.134	**-0.535****	-0.006	0.181	-0.018	-0.075	0.240	0.257	4.35	0.66	0.432	0.00
Behavioural Regulation	-0.073	0.144	0.146	**-0.394****	0.103	0.101	-0.061	-0.179	0.274	-0.248	2.740	0.569	0.324	0.00
Personal Care Awareness	-0.102	0.033	0.072	**-0.346***	-0.038	**0.230***	-0.066	-0.195	-0.118	-0.169	3.865	0.635	0.403	0.00
Safety	-0.198	0.082	0.112	**-0.289***	0.145	0.124	-0.062	-0.210	0.221	-0.284	2.588	0.558	0.311	0.00

Bold indicates statistically significant correlation regression analysis

Our research has shown that manipulation skills (according to the MACS scale) have the greatest influence on participation of pupils with CP in out of all of the examined predicted factors. Gross motor skills measured by the GMFCS scale proved to be the second important predictor. Both values, MACS and GMFCS, proved stronger in performing physical in comparison to cognitive-behavioural activities. Intellectual status is the third predictor which proved to be important in performing all cognitive-behavioral and one physical activity. Slightly less important for the participation of these students is the ability to write. The presence of epilepsy is another significant predictor limiting participation when performing five cognitive-behavioral tasks and in one physical aktivity. The ability to speak comes next, while at the end of the list there is the presence of visual impairment, younger age and female gender as factors that have a negative impact, each on performing of the one physical school activity. The predictor type of the school that students attend did not show statistical significance in our study. In order to summarize a large number of data, we have also shown the results of predictors of social participation by frequency in the chart no. 1.

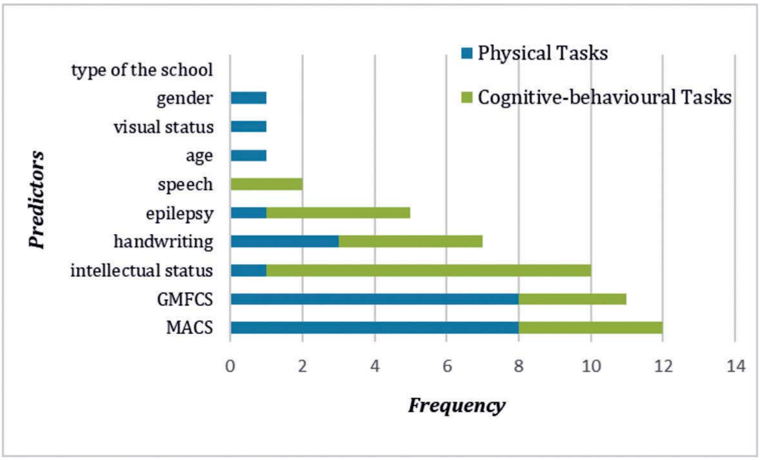

Chart 1. Predictors of social participation of pupils with CP in primary schools by frequency and representation by the task type (physical or cognitive-behavioural).

DISCUSSION

Our results correlate with the results of previous studies in which Kerr et al., (2007), Østensjø et al., (2003) and Schenker et al., (2005), refer primarily to the level of motor functioning (gross and manual) and then to intellectual capacities of students with CP (Mo Dang et al., 2015; Vorman et al., 2006) as the most important predictors for the participation of these children in the school environment.

Research has shown that writing ability plays a high role in participation, which is logical, given the high dependency of manipulative skills and participation on the most of school activities. If we proceed from the fact that writing ability is the most complex form of manual activities, for the performance of which it is necessary to meet a number of sensorimotor conditions, namely the development of visual perception, fine motor skills, attention, memory, orientation and lateralization, which are the result of complex nervous mechanisms (Nikolić, 2012; Opatrilova, 2014;), this finding raises a new question: To what extent does each of these components actually affect the overall participation of pupils with CP?

The predictor presence of epilepsy showed statistical significance in the intensity of social participation of students with CP, especially when performing cognitive-behavioural tasks. This result was somewhat expected due to previous research of Schenker (2005) and Vorman (2006) which have shown that the presence of epilepsy affects social life and communication and reduce the level of participation of children with CP in the school environment. Therefore, the presence of epilepsy in children with CP is inversely proportional to their social participation in school.

Our research has shown that the predictor speaking ability is not as highly correlated with school participation as in the case of other studies (Ghaffari et al., 2020; Mei et al., 2014; Zulic et al., 2018). It could be explained by the influence of other predictors affecting speech, given that we used regression analysis which takes into account the interactions between the all predictors examined. The expressive speech we examine in the research is the part of motor functions, respectively, the motor function took the role of a mediator in speech as a predictive variable. Also, our sample were consisted of only ten students with expressive speech disorders, therefore, according to this criterion we have not had an adequate sample and these results should be taken with reserve.

The predictors with the least recorded significance in all analyses are age, gender and visual status of students with CP. The sample in this study was adequately widespread with respect to the variables of age, visual status and gender, according to the representation in the population so, as a significant factor in the effectiveness of the research, the size of the sample was imposed. The authors propose the further examination of the predictor factors visual impairments and gender in a larger sample of pupils with CP.

We have determined that adequate inclusion in the school environment requires successful mastering of activities in multiple domains, i.e. successful participation in the school environment requires a number of different developed, primarily individual abilities, the combination of which enables independence in the performance of non-academic school activities. The diversity of our results is in accordance with the nature of CP characterized by a wide range of impairments. Therefore, it is expected that the participation of students with mild impairments is generally achieved to a greater extent, while students with multiple disabilities tend to have greater restrictions on participation in the school environment.

CONCLUSION

The basic goal of our research was to determine the predictors of social participation of pupils with CP in primary schools in Serbia. The participation of pupils with CP in the school environment was examined during the independent realization of non-academic school activities, according to the SFA tool (Coster, 1998). As predictive variables, the factors that have previously been reported to have a significant effect on pupils' independence in performing these activities in the school environment have been identified. These predictive factors included nine personal characteristics of students with CP and the one environmental factor - the type of school the pupils attend.

This study shows that participation of pupils with CP in school activities is positively correlated with the level of gross motor functions and manipulation skills, intellectual abilities, writing skills and the presence of epilepsy, while the effect of speech skills has not been clearly demonstrated and that it requires further examination on a larger and more representative sample of pupils with CP. We also pointed out that age, gender, visual status and the type of school that students attend do not have a statistically significant effect on the participation of pupils with CP.

From this we can conclude that activities aimed at improving the individual capacities of students with CP (physical, manual, cognitive) are the basis for their successful social participation in primary schools. Given that the most common focus of customized educational programs is on reducing or compensating functional limitations of students with CP, it is very important that non-academic activities, in addition to academic ones, be included in the assessment of students' abilities. In this way, experts in working with these students will have a more complete knowledge of their functionality and thus provide more adequate individual support to successfully overcome their academic and social challenges.

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LEXICAL-SEMANTIC PROCESSING OF NOUNS IN PRESCHOOL CHILDREN[a]

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SUMMARY

The aim of the study is to determine the characteristics of lexical-semantic processing of nouns in children aged five and a half to seven years. The sample consists of 60 children, of which 30 (50%) are boys and 30 (50%) are girls. In relation to age, the sample of children is divided into three age groups with an age interval of six months. In order to research lexical-semantic abilities, the Test of speech development-Test of word definitions and the Semantic test were applied.

The results of the study show that preschool children most often produce functional definitions (31%), while the literary and descriptive definitions (18%), as well as logical definitions (17%) are almost equally represented in the answers of children.

When analyzing the results of semantic abilities, it was found that children achieve the best performance on the antonyms task, while the lowest achievement was accomplished within the synonyms task. Only on the antonyms task statistically significant differences were identified in achievement between the youngest and middle-aged group, in favor of older children ($p < 0.05$).

Boys and girls show similar tendencies in development of different abilities, measured by overall performance on all tasks, as indicated by the absence of interaction betwen age and sex factors ($p > 0.05$).

The importance of children`s vocabulary development and its impact on school performance has been the subject of many studies. A well-developed vocabulary in children is part of their language competence and contributes to development of adequate communication skills, therefore, the linguistic indicators we used in our study represent a significant indicator of lexical-semantic development.

Key words: lexical ability, semantic ability, preschool age

INTRODUCTION

Numerous linguistic and non-linguistic factors affect the storage and processing of linguistic information in verbal communication process. At the lexical level of language production, there are three causes responsible for the success of language information processing. The first cause relates to the length of words expressed through the number of phonemes or syllables, type of words and their morphological characteristics. The second cause involves the mutual relations among the words in language corpus (e.g., frequency of words used in the text), while the third cause involves factors that influence the speed and accuracy of recalling words from the mental lexicon (eg, concreteness/abstractness of words) (Erdeljac & Sekulić-Sović, 2018).

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The development and enrichment of children`s vocabulary is a timeless process. The intensity of this process is greater during period of marked lexical development and decreases over time, but never completely cease. Placing words in a relations through the creation of neural networks of the mental lexicon allows the child to reach the level of abstraction, with the knowledge that a large number of terms can be labeled with a single name, and that there are certain links between them (Aitchinson, 1998).

In Ferdinand de Sosir's theory (Sosir, 1989), one of the major dichotomy in language is division into syntagmatic and paradigmatic relations. Syntagmatic relations exist among words, whose relations are based on the linear character of language (e.g. fragrant-flowers), while paradigmatic relations occur among words that have an associative relations (e.g. glass-mirror). The most commonly studied paradigmatic lexical relations (synonyms, homonyms, antonyms, and metonyms) are also called semantic relations between words, because they are based on mutual similarity of meaning. However, in addition to the similarities that exist between words in some of these relations, there are some differences. In the case of synonyms, the difference reflects in the name for the concept, i.e. synonyms are two lexical units with the same (or similar) meaning (house-home) (Jakić, 2016). Antonyms represent two lexical units opposite in meaning (good-evil) (Crystal, 1996), while the metaphor connects two domains - source and goal, and with it, unknown can be uttered with the help of well-known, as in the example "Beware of him, he is a real fox" (Omazić & Šoštarić, 2005). Homonymy is a relation between two lexemes of the same expression but of a different meaning (palm-as a tree; palm-as a part of a hand).

The development of the word definition ability is a gradual process, beginning in preschool period and continuing throughout schooling (Al-Issa, 1969; Marinellie & Chan, 2006; Marinellie & Johnson, 2003; Storck & Looft, 1973; Swartz & Hall, 1972). In children younger than five years, definitions tend to be concrete and functional. With age, definitions become more abstract (Kikas, 1993; Skwarchuk & Anglin, 1997), which correlates with the development of their mental lexicon, as well as increasing awareness that superior terms are conventionally used in definition and organization of concepts.

Words are a crucial component of comprehension and the building blocks of language. They provide a link between a phonological (or orthographic) form and a referent, resulting in a unit of meaning that can be understood and shared between people. A word contributes to the meaning of a sentence but at the same time, the meaning of the word is in part a product of the sentence and context in which it appears. Therefore it is not surprising that children who struggle with language during development often have difficulty dealing with words. This is most obviously when a child has an impoverished vocabulary: not knowing the meaning of a particular word has clear and detrimental implications for comprehending language which contains that word (Nation, 2014).

The word definition ability as early as on preschool age is closely related to development of verbal expression, intellectual functioning, and overall academic achievement at older age. Success on word definition tasks requires not only understanding the meaning of words, but also the ability to express the knowledge clearly, which is a combination of cognitive and metalinguistic competences (Newcomer & Hammill, 1997; Nippold, Hegel, Sohlberg & Schwarz, 1999; Snow, 1990; Watson, 1995).

Numerous studies point to the fact, that development of lexical-semantic abilities is a necessary prerequisite for mastering other levels of linguistic structure. In Roth, Speece & Cooper's (2002) research, semantic development assessed through the word definition tasks was the most significant indicator of reading development. The importance of lexical and semantic abilities, as an indicators of linguistic development, has been recognized by numerous authors in their studies (Frost, Madsbjerg, Niedersoe, & Olofsson, 2005; Hammill, Mather, Allen, & Roberts, 2002). Undeveloped structure of semantic network results in limited semantic knowledge, which in turn leads to errors in naming, reading, and writing skills (de Vries, 2012; Baba, 2009). Semantic development is intense during the preschool period, continues during the school period and lasts during the adult's life. Unlike phonology and grammar, it is not completed and there are always new words to learn (Golubović, 2016, 2017).

METHOD

Considering that development of lexical-semantic abilities is intense during the preschool period, the main aim of the study is to determine the characteristics of lexical-semantic abilities in preschool children. A specific aim of the study is to determine the characteristics of lexical-semantic processing of nouns in children aged five and a half to seven years.

Participants

The sample consists of 60 children, of which 30 (50%) are boys and 30 (50%) are girls, aged five and a half to seven years. In relation to age, the sample is divided into three groups with an age interval of six months. A detailed view of children in our sample, in relation to age and gender categories is presented in Table 1.

Tabel 1. *Distribution of boys and girls in age subgroups*

Age	N	Boys	Girls	Average age in months
I group (5.6 – 6.0) years	20	10	10	68
II group (6.1 – 6.7) years	20	10	10	76
III group (6.8 – 7.2) years	20	10	10	81

Instruments

In order to investigate lexical-semantic abilities in children, two instruments were used:

1. *Test of speech development-Test of word definitions* (Vasić, 1991). The test consists of five questions. The child has a task to answer the questions: *What is a human? What is a mother? What is life? What is a house? What is the sun?* The examiner-speech therapist records the answers in the test form. Children's responses can be analyzed in different ways. In our study, we decided to quantitatively and qualitatively analyze the obtained answers. According to the test instructions, a category of definitions is defined for each item. After that, each definition is assigned from 0-7 points, depending on the type of definition.

2. *Semantic test* (Vladisavljević, 1983). The test is used as a diagnostic tool in speech therapy practice to examine the meaning of certain words and their associations, and thus is an indicator of child's thinking and linguistic abilities. It consists of four subtests, each subtest containing ten items. With these four subtests, the following word categories are examined: *homonyms, synonyms, antonyms* and *metonyms*. The examination is conducted individually. Before performing the test, the child is instructed and explained what is expected from him. The child's responses are analyzed quantitatively and qualitatively.

Examining procedure

The research was conducted in February and March 2020 at the Preschool institution "Čika Jova Zmaj" in Belgrade. Kindergartens in which we conducted research are from city core of Belgrade. The children from our sample have regular anatomical and functional status of the speech organs, without the presence of sensory, motor and emotional disorders. The sample consists of children who, according to data obtained from pedagogical and psychological documentation, have at least average intellectual abilities. All children in our sample are monolingual and their mother tongue is Serbian. Assessment of lexical and semantic abilities is done by individual testing of children in separate rooms, with the permission of the parents, teachers, head of the institution, as well as voluntary consent of the child. Solving tests was independent and was not time-limited. The children were instructed what they are supposed to do depending on the test, as well as an explanation from the speech therapist that these tests had no impact on their success in kindergarten activities.

Statistical methods

In addition to measures of descriptive statistics, one-factor and two-factor analysis of variance were used in data processing. Data analysis and data processing were performed using the Statistical Package for the Social Sciences (SPSS).

RESULTS

The achievement of preschool children on word definition tasks are presented in Table 2.

Analyzing the results of three age groups of children in relation to the type of definitions, it was found that children were most successful on the *What is a human?* task, since 33% of children answered in the form of *logical definitions*. In addition, most definitions that indicate higher levels of lexical-semantic development was found on the *What is the sun?* task. On this task, 16% of children answered in the form of *logical definitions*, while 22% of children answered in the form of *descriptive definitions*.

In the task *What is a mother?*, children's answers are dominated by definitions in the form of *echolalia* (eg, *Mother is mom* - 27%) and *functional definitions* (eg, *Mother is cleaning, working, ironing….* - 29%), while 6-12% of children answered in the form of *literary*, *descriptive* and *logical definitions*. The largest percentage of children (62%) answered in the form of *functional definitions* on the *What is a house?* task, while other forms of definitions are found in less than 8% of children in the sample.

Table 2. *Distribution of definitions in three age groups of preschool children*

Questions		0		1		2		3		4		5		6		7	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
What is a human?	I	4	20	1	5	6	30	2	10	1	5	/	/	4	20	2	10
	II	1	5	1	5	3	15	2	10	3	15	1	5	8	40	1	5
	III	1	5	2	10	2	10	5	25	3	15	2	10	4	20	1	5
What is a mother?	I	/	/	9	45	1	5	3	15	2	10	1	5	/	/	4	20
	II	1	5	3	15	/	/	5	25	2	10	4	20	2	10	3	15
	III	1	5	4	20	1	5	9	45	1	5	2	10	2	10	/	/
What is life?	I	1	5	8	40	8	40	1	5	1	5	/	/	1	5	/	/
	II	3	15	10	50	2	10	4	20	/	/	/	/	/	/	1	5
	III	3	15	7	35	2	10	5	25	1	5	1	5	1	5	/	/
What is a house?	I	1	5	2	10	1	5	12	60	1	5	1	5	/	/	2	10
	II	1	5	2	10	/	/	12	60	1	5	1	5	1	5	2	10
	III	1	5	/	/	/	/	13	65	/	/	3	15	2	10	1	5
What is the sun?	I	2	10	1	5	3	15	4	20	2	10	5	25	2	10	1	5
	II	2	10	/	/	/	/	9	45	2	10	4	20	1	5	2	10
	III	1	5	/	/	1	5	6	30	4	20	4	20	2	10	2	10

Legend: *response categories*- 0 (NO answer); 1 (echolalia); 2 (wrong answer); 3 (functional definition); 4 (literary definition); 5 (descriptive definition); 6 (logical definition); 7 (a specific logical definition) *age groups*- I (the youngest group: 5.6-6.0 years); II (the middle aged group: 6.1-6.7 years); III (the oldest group: 6.8-7.2 years)

The lowest percentage of definitions that indicate higher levels of lexical-semantic development is found in task *What is life?*, where 96% of children answered in the form of definitions: *no answer, echolalia, wrong answer* and *functional definition*. Figure 1 shows the overall frequency of different types of definitions in children's answers.

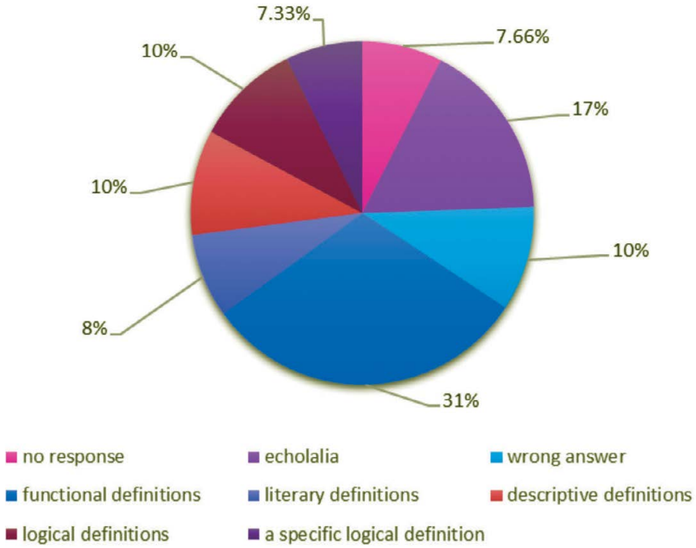

Figure 1. The frequency of different types of definitions in preschool children

The results of frequency of different types of definitions show that preschool children most often produce *functional definitions* (31%), while *literary* and *descriptive definitions* (18%), as well as *logical definitions* (17%), are almost equally represented in children's answers. Lower levels of lexical-semantic development were found in the form of definitions: *no answer* (7.66%), *echolalia* (17%), and *wrong answer* (10%). Table 3 shows the results of developmental trend on Word definition tasks in three age groups of preschool children.

Table 3. *Developmental trend of word definitions in preschool children*

	M	SD	Min	Max	F	df	p
I group	14.65	6.54	1	26	0.96	2	0.38
II group	16.20	4.43	11	26			
III group	16.95	4.83	7	27			
Boys	16.70	5.53	7	27	1.23	1	0.27
Girls	15.17	5.12	1	25			

These results show that different forms of definitions do not differ significantly in three age groups of children ($p > 0.05$). In addition, there were no statistically significant differences between boys and girls achievement on Word definition tasks ($p > 0.05$).

Analyzing the results obtained using percentile rankings, the correct answers of children are divided into four categories - up to the 25th percentile - *the lowest achievement*, up to the 50th percentile - *the average lower limit*, to the 75th percentile - *the average upper limit* and above 75th percentile – *the highest achievement*. Children that are at or below the 25th percentile have up to 12 points, the 50th percentile is at 16 points, while children that are at or above 75th percentile have between 21 and 35 points.

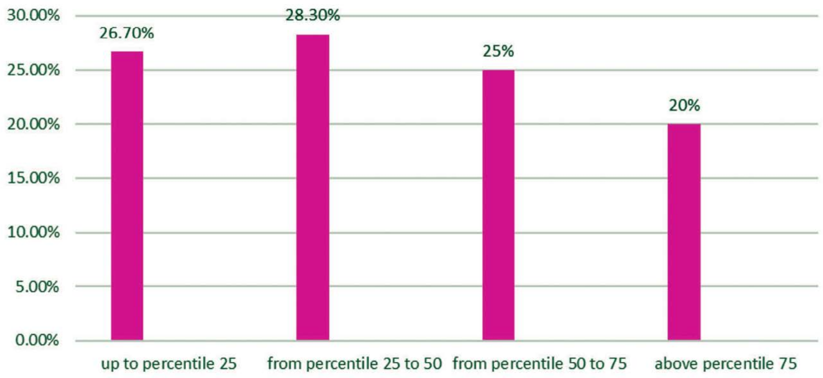

Figure 2. Children's achievement on Word definition tasks according to percentile ranks

The results of the percentile rankings show that 53.3% of children have an average achievement scores on Word definition tasks, namely: 28.3% of children at the average lower limit and 25% of children at the average upper limit. The lowest achievement scores are obtained in 26.7% of children, while the highest achievement scores are obtained in 20% of children. Table 4 shows the results of developmental trend of Semantic abilities in three age groups of preschool children.

Table 4. *Developmental trend of semantic abilities in three age groups of children*

Semantic test		M	SD	Min	Max	F	df	p
homonyms	I	4.87	2.64	0	9	1.40	2	0.25
	II	4.87	2.75	0	10			
	III	6.10	2.60	2	10			
synonyms	I	3.20	1.93	0	6	0.22	2	0.79
	II	3.45	1.70	0	7			
	III	3.65	2.60	0	10			
antonyms	I	4.70	2.20	0	9	3.82	2	0.02*
	II	6.00	1.53	4	9			
	III	6.42	2.33	0	10			
metonyms	I	3.52	2.41	0	9	0.75	2	0.47
	II	4.42	2.65	0	10			
	III	4.45	3.04	0	10			

Legend: *age groups*- I (the youngest group: 5.6-6.0 years); II (the middle aged group: 6.1-6.7 years); III (the oldest group: 6.8-7.2 years)

The data from Table 4 show that highest average scores are obtained on the *antonyms* task (5.70 points), while the lowest average scores are obtained on the *synonyms* task (3.43 points). On the *homonyms* task, the average test score was 5.28 points, while on the *metonyms* task, the average test score was 4.13 points. The results of the study show that, relative to total sample, there are no statistically significant differences in achievement between three age groups of children on the tasks *homonyms, synonyms* and *metonyms*. On the contrary, on the *antonyms* task we found that middle aged group performed significantly better than youngest group (F = 1.72; df = 2; p = 0.03). Table 5 shows the results of total achievement in three age groups of children on the Semantic Test.

Table 5. *Total achievement in three age groups of children on the Semantic test*

	Semantic test				F	df	P
	Min	Max	M	SD			
I group (5.6-6.0 years)	5	32	16.20	7.54	1.56	2	0.21
II group (6.1-6.7 years)	12	32	19.12	5.92			
III group (6.8-7.2 years)	5	37	20.20	8.50			

The results of total achievement on the tasks of lexical relations: *homonyms, synonyms, metonyms* and *antonyms* in three age groups of children show that there are no statistically significant differences in achievement on all tasks (p> 0.05). Despite the fact that the highest scores were obtained in the oldest group of children, and that the middle aged group was more successful than the youngest group in overall achievement, this difference is not statistically significant. Table 6 shows the results of total achievement of boys and girls on the Semantic Test.

Table 6. *Total achievement of boys and girls on the Semantic test*

Semantic test	Boys		Girls		F	df	p
	M	SD	M	SD			
Homonyms	5.46	2.64	5.10	2.76	0.27	1	0.60
Synonyms	2.90	1.84	3.96	2.20	4.13	1	0.04*
Antonyms	5.95	1.90	5.46	2.38	0.75	1	0.38
Metonyms	3.93	2.71	4.33	2.72	0.32	1	0.57

The boys obtained the highest scores on the *antonyms* task (5.95 points), as well as the girls, who obtained slightly lower average scores within the same task (5.46 points). Homonyms and metonyms was relatively difficult tasks for all the boys and girls in the sample, since a slightly lower average scores are obtained on these tasks. In the end, the lowest scores was obtained on the synonyms task. The difference in achievement between boys and girls is the most expressed on this task, which is confirmed by the statistically significant difference, in favor of girls (p < 0.05).

Boys and girls show similar tendencies in development of different abilities, measured by overall performance on all tasks, as indicated by the absence of interaction betwen age and sex factors on the *Semantic test* (F = 1.25; df = 5; p = 0.29) and *Word definition tasks* (F = 1.18; df = 5; p = 0.33) (Figure 3 and 4).

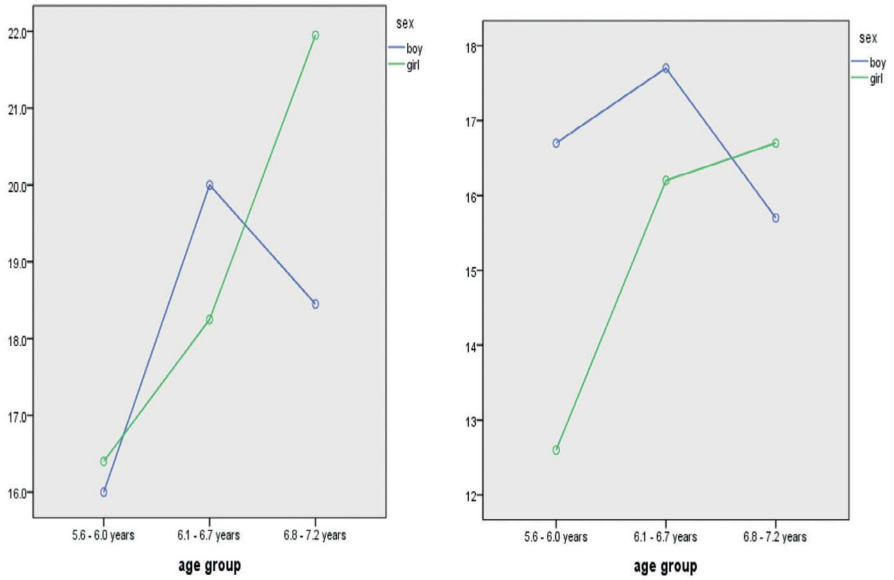

Figure 3 and 4. Sex-age interaction on the Semantic test and Word definiton tasks

Analyzing the results obtained using percentile rankings, the correct answers of children are divided into four categories - up to the 25th percentile - *the lowest achievement*, up to the 50th percentile - *the average lower limit*, to the 75th percentile - *the average upper limit* and above 75th percentile – *the highest achievement*. Children that are at or below the 25th percentile have up to 13 points, the 50th percentile is at 18.5 points, while children that are at or above 75th percentile have between 24.6 and 37 points.

	homonymes	synonymes	antonymes	metonymes	total
■ up to percentile 25	20%	35%	26.70%	26.70%	28.30%
■ from percentile 25 to 50	30%	20%	31.70%	31.70%	21.70%
■ from percentile 50 to 75	13.30%	25%	20%	16.70%	25%
■ above percentile 75	36.70%	20%	21.70%	25%	25%

Figure 5. Children’s achievement on all tasks on the
Semantic test according to percentile ranks

The results of the percentile rankings show that 28.3% of the children have the lowest achievement scores, while 25% of the children have the highest achievement scores on the tasks of semantic abilities. The average achievement was found in 46.7% of the children in the sample, namely: 21.7% of children at the average lower limit and 25% of children at the average upper limit.

Analyzing the results of children on individual tasks, we found that highest percentage of children have the highest achievement scores on the *homonyms* task (36.7%). On the other hand, the highest percentage of children have the lowest achievement scores on the *synonyms* task (35%) (detailed in Figure 5).

DISCUSSION

Preschool children intensively develop the ability to define concepts - nouns, during the preschool period. In that regard, our results showed the highest percentage of *functional definitions*, as well as smaller percentage of *literary*, *descriptive* and *logical definitions* in preschool children. Categories of *functional*, *literary*, and *descriptive definitions* implies an answer that includes basic semantic characteristics for the given term, which is typical for preschool children, while *logical definitions* besides semantic characteristics also include figurative meaning, which is typical for school age (Golubović, Guberinić, Ječmenica & Živković, 2019).

Our results support numerous previous findings, that definitions of young children consist of a “mere outline, a framework of bar eessentials” which is filled in as the child matures (Markowitz & Franz, 1988). Gray and Holmes (1938) reported that the word definitions of young children express action and use, and that descriptions, synonymes, and classifications are not used. Conceptan (1916) showed that children aged five and six define words on the basis of use but by the age of nine, children preferred definitions “superior to use”, such as descriptions, classifications, and specifications of material.

Piaget (1928) theorized that functional definitions were linked to the earlier, egocentric thinking of young children (through age eight) whereas logical or formal definitions were seen as an expression of the more formal or conceptive thought patterns of older children (beginning at age nine). Some research showed that functional definitions are the earliest form of definitions, predominating from age five to age nine. During that period, functional definitions slowly decrease in percentage, while abstract definitions slowly increase. By age eleven, abstract definitions are more frequently used than the other two forms. The status of concrete or descriptive definitions is not entirely clear from the research, although they appear to develop somewhat later than functional definitions and to decline before the age of nine or ten when abstract definitions become dominant (Al-Issa, 1969; Litowitz, 1977; Swartz & Hall, 1972). These findings are in line with our study results, since we found that the structure of children’s definitions does not change significantly during preschool age, and that at the age of five and a half to seven years *functional definitions* are dominant.

In preschool children, definitions are not completely informative for the communication partner, as in the case of adults, while progress during education results in development of *logical definitions* (Benelli, Arcuri & Marchesini, 1988). When a child does produce a "good" definition, it seems to be reliable evidence that he knows that particular word quite well and can use the word for linguistic purposes (Johnson & Anglin, 1993). Consequently, many authors believe that children's definitions provide indirect evidence of the important process of vocabulary acquisition (Nagy & Herman, 1987).

On Word definition tasks, children's success was largely influenced by the concreteness and frequency of the stimuli tested, which is supported by the results of our research. With the exception of *What is a mother?* task, where 27% of children produced a definition in the form of *echolalia*, in our study as the most frequent and the most concrete terms *home* and *sun* stood out. Specifically, on these tasks the lowest frequency of *omissions*, *echolalia*, and *incorrect answers* was obtained. On the other hand, the highest percentage of *logical definitions* is obtained on *What is a human?* task, from which we conclude that definitions in 33% of children are at the level of younger school age for this concept.

Results of our study support findings, that ability to produce high-quality, formal definitions is not applied consistently to all nouns, even by adults (McGhee-Bidlack, 1991; Miller, 1991). Many words that are known receptively cannot be defined well, perhaps, because specific word characteristics influence the relative difficulty of the definitional task. For example, concrete nouns are easier for both children and adults to define than abstract nouns of equal familiarity (McGhee-Bidlack, 1991; Reynolds & Paivio, 1968).

High percentage of *logical definitions* suggests greater breadth and depth of children's knowledge for a given concept. Definition is a skill that relies on linguistic knowledge. The linguistic component includes the knowledge of appropriate categorical terms as well as characteristics of a word that distinguish it from other words in the same category, while the metalinguistic component refers to the knowledge of how to define. Definition is also a skill that depends on retrieving stored words and terms in order to provide complete information that is useful to the listener or reader (Nippold, 1988). Awareness that a given concept, in addition to basic semantic characteristics also can have a figurative meaning, is part of the *logical definitions* in children and indicates a higher knowledge of semantics (Golubović, Ječmenica, & Kobac, 2018). Once a child has reached a certain level of cognitive and lexical maturity, he or she is able to define the meaning of a term by noticing its general and special characteristics, which differentiate it from other concepts (Kašić, 2002).

Development of lexical relations is most expressed on the *antonyms* task, while *synonyms* are the category in which preschool children need additional encouragement. The results of our study are in line with the fact that children first develop the ability to find a large number of meanings within a word, and then to establish other semantic relations among lexemes (Vladisavljević, 1983). Children have problems learning words when there is not a one-to-one mapping between the word and its meaning. Most interest has focused on words with overlapping extensions such as synonyms. However, children also have difficulty correctly interpreting homonymous terms even when both meanings are in their lexicon (Woodward & Markman, 1998). Beveridge & Marsh (1991) showed that six-year-olds still have difficulties, and a study by Mazzocco (1997) suggests that children's difficulty in overriding the familiar meaning of a homonyms persists until children are at least 10 years. The results of the research are in line with our findings, since on the homonyms task children in our sample scored an average 5.28 out of a maximum 10 points. On homonyms tasks, with no further information to guide them in their answers, children up until the age at least six often make wrong interpretations (Campbell & Bowe, 1983). Doherty's (2004) study suggests that children have genuine difficulties learning secondary meanings of homonyms, and these difficulties persist at least until the age of ten. Research shows that when the primary referent of the homonym is absent, children are quite good at identifying the intended meaning. This is the more common situation in real life, so children's actual problems with homonymy are unlikely to be serious.

One of the explanations why preschool children are not so successful at the *homonyms* task is in the fact that, children assume each meaning is represented by a distinct form. Children might therefore fail to deduce a second meaning for a known word because they assume known words cannot have second meanings (Slobin, 1985). Semantic development still continues through the school age, which in turn leads to an improvement in knowledge of the word meanings and development of metalinguistic skills. The same pattern of lexical development was found in a study of young school children. In a sample of 64 children, aged eight to ten, it was found that number of points on all lexical relations tasks, especially on synonyms task, increased with age (Golubović & Ječmenica, 2018).

According to our study results, the development of lexical relations is most expressed within the *antonyms*. Some research have found that children appreciate antonymy from very young ages and understand them quite naturally. Children from ages two to five not only use antonyms in their utterances, but that they often did so at higher type of use than the adults speaking to them. Antonymy is present in children discourse from the earliest ages (Jones & Murphy, 2005). Clark (1972) found that children as young as four could provide a correct opposite answer to some of the stimulus words, while spontaneous usage of antonyms was found in children as young as two years old (e.g., "He's a girl and you're a boy") (Jones & Murphy, 2005).

Our results are in line with previous studies, where it was found that children's accuracy on the antonyms task improves with age (Phillips, 2013). Antonyms use was always proportionally greater in child-produced speech than in child-directed speech and was also found to significantly increase in child-produced speech with age, a change that was not paralleled in the child-directed speech (Jones & Murphy, 2005). Heidenheimer (1975) found that there was a significant increase in antonyms production in a word association task between the ages of 5.3 and 5.9, but that children as young as 4.0 would spontaneously produce antonyms in this word association task, suggesting that even these young children have a nascent understanding of antonyms, or at the very least the words that form an antonymic pair are beginning to be linked to each other by these young children. Heidenheimer (1978) evaluated children in grades 1, 3 and 5 and found that children production of synonyms lagged behind their production of antonyms in a word association task, and that the production of synonyms increased significantly with age.

An explanation why children on the Semantic test in this and other research (Golubović & Ječmenica, 2018) have the lowest achievement on *synonyms* task, we looked for in Huford (2003) study. According to this author, pure synonymy is rare. By contrast, homonymy is common in languages. Markman (1989) notes a disposition in children to assume, initially at least, that no two words may overlap in meaning. Some authors have also proposed an innate *Uniqueness Principle* which prevents the child from internalizing more than one form per meaning (Pinker, 1984; Wexler & Culicover, 1980). Human avoidance of synonymy is plausibly innate, according to Hurford (2003).

By analyzing errors on the lexical relations tasks, we identified the most common types of errors: *phrase* (answer in the form of a phrase); *no + stimulus answers* to *antonyms* task; *omissions* (absence of answer); *derived answers* (phonologically similar to stimulus words, answers derived from stimulus words) and *semantic errors* (words that are semantically close to stimulus words). Since linguistic understanding depends on the complexity of child's knowledge of the meaning relations between words and the accessibility to this knowledge, in this way, we can explain the presence of errors on the *homonyms, synonyms, antonyms* and *methonyms* tasks in children from our sample. On the lexical relations tasks, it is necessary that stimulus word activate the production of other meaning related words, through the semantic network. In this way, underdeveloped connections within the semantic system lead to the production of incorrect answers in fewer children.

CONCLUSION

The importance of vocabulary development in children and its impact on school performance has been subject of many research. The lexical richness in children correlates with success in acquiring reading and writing skills. A well-developed vocabulary in children is part of their language competence and contributes to the development of communication skills, therefore, linguistic indicators we used in our study represent a significant indicator of lexical-semantic development.

As an idea for further research in this area, we suggest consideration of the factors that slow or encourage the development of lexical-semantic abilities. Factors such as school success, better communication skills, and higher levels of intellectual functioning inevitably affect lexical processing and semantic development.

Defining words, homonyms, synonyms, antonyms and metonyms are tasks in which children consciously use their linguistic capacities. Therefore, by nature, intervention for these abilities may help promote linguistic awareness. Recent research has emphasized the integral relation between linguistic skills and success in school. Given the close link between definition skills, linguistic awareness, and academic success, it is essential that investigators continue this line of research in children with typical language development and language impairment.

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BEHAVIORAL ASPECT OF WORKING MEMORY IN CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT[a]

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SUMMARY

Despite the normal range of non-verbal intelligence, children with specific language impairment (SLI) can exhibit a number of cognitive limitations, especially in the area of working memory (WM) and inhibition. There is a growing body of research indicating possible common underlying interactive neural substrates for language and nonverbal processing. While there are quite a number of studies that have well documented WM deficits in SLI children in clinical settings, there are very few that have studied WM performance in everyday situations in these children. Aim of this study is to examine behavioral aspect of WM in children with SLI at preschool and early school age. The sample consisted of 51 children with SLI, ages between five and eight years. For the purpose of an assessment of behavioral aspect of WM, Working Memory subscale from Behavior Rating Inventory of Executive function (BRIEF) was used. Results showed that as a group, SLI children are on the verge of underperformance (57.82 average T – scores). Detailed analysis showed that 27.5% of children with SLI have poor performance, while 37.3% of children exhibit underachievement in behavioral aspect of WM. Sex related differences were found in a group of SLI children with normal WM achievement, suggesting some male developmental advantages (p = 0.021). Significant number of SLI children exhibit difficulties in the area of behavioral aspect of WM. This implicates the need for a more extensive assessment of SLI children, as well as the need for interventions that target executive abilities in natural context in these children.

Key words: specific language impairment, working memory, behavioral aspect

INTRODUCTION

Working memory: basic concept, development and evaluation

Generally speaking, working memory is an active memory system responsible for the temporary retention and simultaneous processing of information (Bailiss, Jarrold, Baddeley, Gunn, & Leigh, 2005). Additionally, working memory is also described as the use of temporarily withheld information in performing more complex cognitive tasks (Hulme & Mackenzie, 2014), or as a mental workspace for the use of activated representations from long-term memory (Stoltzfus, Hasher, & Zacks, 1996). Based on Baddeley model (2006), working memory is a multiple resource system connected to a number of limited capacity subsystems. This model also includes a central executive system associated with attention control, high levels of processing and coordination of

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activities within working memory. Described memory system allows one to monitor commands while completing a task, write complex sentences by memory, understand written text, or, for example, verbally solve arithmetic tasks (Buha & Gligorović, 2012).

There is still a debate in the literature on the relationship between working and short-term memory. While some authors consider these to be two inseparable and interdependent systems, other authors consider short-term and working memory to be two completely separable cognitive systems (Dehn, 2011). However, a number of recent studies support the second view and make a clear differentiation of short-term memory (STM) and working memory (WM) (Dehn, 2011):

Short-term memory	**Working memory**
Retains information passively	Actively processes information
Modal related capacity (verbal and visual)	Relatively modal independent
Less closely related to learning and higher cognitive functions	More closely related to learning and higher cognitive functions
Automatically activates information stored in long-term memory	Consciously activates desired information from long-term memory
Has no control function	One of executive abilities
Can be active independently from long-term memory	Activity depends significantly on components of long-term memory
Retains information coming from outside	Retains the “products” of various cognitive processes

Accordingly, working memory manages, manipulates and transforms information retrieved from short-term or long-term memory. However, it is difficult to limit working memory and detach it from related cognitive processes, such as reasoning. In general, working memory is the central cognitive process responsible for the active processing of information. Therefore, working memory underlies both, complex and basic cognitive processes (Ile Lepine, Barrouillet, & Camos, 2005). Working memory supports cognitive processing as a sort of intersection between perception, short-term memory, long-term memory and goal-directed actions.

Although there are individual differences, working memory capacity is quite limited, even in a person with a normal working memory range. Typical individual can only manipulate with around four pieces of information at a time (Cowan, 2001). Additionally, if information is not manipulated, it will remain in working memory for only a short period of time, about 2 seconds (Swanson, 2000). Because of its’ central role in cognitive functioning and learning, successful learning is highly dependent of working memory. For example, it is likely that a child with a severe impairment of verbal working memory will have reading difficulties at older age (Masoura, 2006). Moreover, considering working memory limitations, efficient use of all resources is important for all individuals, not just for people with cognitive impairments.

Basically, working memory is one of the main cognitive processes underlying thinking and learning. By efficient utilization of different memory systems, working memory enables us to learn and unify thoughts and ideas. In daily activities, we are constantly dealing with demands and goals that compete within the limited process ability of working memory. However, activation of the working memory is not required for all cognitive operations or behaviors. A number of cognitive functions and behaviors can be performed in a fairly automatic manner, which rely a little or even do not rely on working memory (Unsworth & Engle, 2007). However, working memory is necessary for mastering the skill that leads to the level of automation. It is also necessary for processing of new information, resolving problems or situations, maintaining of main goal awareness, retaining new information, and for consciously retrieving information from long-term memory.

Working memory plays an integral role in higher level cognitive activities, including reasoning, comprehension, and executive functioning (Dehn, 2007). The processes that are linked most closely with working memory include attention, phonological processing, executive functioning, fluid reasoning and processing speed (McNamara & Scott, 2001). Also, working memory capacity sets limits on related higher level processes (Conners, Rosenquist, & Taylor, 2001). Therefore, working memory deficits may affect the poorer performance of other cognitive processes.

During development, working memory increases two to three times between the fourth and sixteenth years, with a steady increase after the eighth year (Gathercole, 1999). According to Gathercole et al., (2004), six-year old child has all components of working memory. Same authors state that the further development of working memory structure does not change significantly, and that it resembles the structure of working memory in adults. However, while the working memory of children and adults is similar in a term of structure and processing, there are still some differences. In children, working memory depends more on phonological short-term memory than in adults. Specifically, the phonological features of words influence processing in children, while adults rely more on semantic associations. Supporting this, research findings have shown that children experience significantly more difficulty in phonological discrimination and non-word tasks comparing to adults (Conlin & Gathercole, 2006). During development, the strength of the links between working memory and other cognitive abilities changes, the functioning and interaction of cognitive components develops, and a person learns how to use working memory for various purposes. Thus, for example, the results of the Gathercole et al., (2004) study showed that, from age six to age fifteen, correlation between working memory and phonological short memory is increasing significantly.

For the purpose of working memory assessment, various memory span tasks are used. Those tasks commonly contain processing elements such as sentence reading or mental rotation, while retaining information that is evoked later. Typically, such tasks are constructed in the direction of more complex and longer ones, measuring the range of capacities until a recall error occurs. As in case of short-term memory assessment, verbal and visuospatial tasks are also used to evaluate working memory. Example of a verbal working memory task is a reading range, in which one is asked to give a meaningful judgment about each sequence of sentences and then remember the last word of each sentence in the sequence (Daneman & Carpenter, 1980). Also, there are numerous tasks that measure the dependency of working memory on other cognitive abilities, as well as those that measure the individual components of working memory. However, some authors state that the main limitation of this kind of assessment is that, by providing materials and instruction in a structured testing context, the examiner is essentially a “surrogate frontal lobe” for the individual (Ylvisaker & DeBonis, 2000;

Anderson, Levin, & Jacobs, 2002). Consequently, due to the strictly controlled structure and organization, one may have normal level of achievement during assessment but still exhibit difficulties in daily activities that require good working memory capacity. To overcome these shortcomings, behavioral scales, such as the Behavior Rating Inventory of Executive Function – BRIEF (Gioia, Isquith, Guy, & Kenworthy, 2000), have been developed. Purpose of this kind of scales is measuring of executive functions in everyday situations, among them working memory too.

Cognitive abilities in children with specific language impairment

Children with specific language impairment (SLI) have difficulties in language development that cannot be attributed to neurological, sensory or environmental factors. However, different genetic and neurological factors may contribute to lag in language development (Bishop, 2009; Law et al., 2004).

According to the International Classification of Diseases (ICD-10), a specific language impairment can be diagnosed to children whose achievement on standardized speech and language assessment tests deviates from at least two standard deviations below average, while non-verbal abilities can deviate a maximum one standard deviation below average (World Health Organization, 2008). Children with SLI demonstrate varying degrees of language comprehension and production problems with deficits in vocabulary, grammatical morphology and syntax. Despite the normal range of non-verbal intelligence, children with SLI can exhibit a number of cognitive limitations, especially in area of memory and executive functions.

The results of previous studies have shown that children with SLI may have short-term memory deficits (Archibald & Gathercole, 2007; Conti-Ramsden, 2003). Moreover, these children can exhibit significant deficit during assessment, averagely 1.27 standard deviations below achievement of typically developing (TD) peers (Graf Estes, Evans, & Else-Quest, 2007). Also, comparing to TD peers children with SLI have significantly lower achievement in the area of both, verbal and nonverbal working memory (Archibald & Gathercole, 2006; Montgomery & Evans, 2009).

Even in the domain of executive functions in general, children with SLI may have significant difficulties. Previous studies have shown that these children have difficulties in sustaining attention in both, auditory and visual domains (Ebert & Kohnert, 2011; Victorino & Schwartz, 2015), as well as with attention shifting (Im-Bolter, Johnson, & Pascual-Leone, 2006). Additionally, the results of numerous studies suggest that children with SLI have significant difficulties in inhibition (Im-Bolter et al., 2006; Marton, Campanelli, Eichorn, Scheuer, & Yoon, 2014; Pauls & Archibald, 2016; Spaulding, 2010). Specifically, when compared to their typically developing peers, children with SLI demonstrate reduced inhibition of prepotent responses (Henry, Messer, & Nash, 2012).

There is a common view that the general processing deficit underlies cognitive impairment in children with SLI, which is associated also with language deficits seen in these children (Tallal, 2004). Difficulties in processing speed are characteristic of children with SLI and children with specific learning disabilities. In support of this, Tallal and Gaab (2006) state that processing speed deficits and delays in sensorimotor development are commonly present in children with SLI.

On the other hand, the results of numerous studies indicate a significant correlation between cognitive and language skills. The role of working memory is particularly emphasized. Van Daal et al., (2008) indicated that phonological working memory is predictive for semantic and syntactic abilities, and that a verbal short-term memory is a strong indicator of vocabulary growth in preschool children (Gathercole, Willis, Emslie, & Baddeley, 1992). Also, verbal short-term memory of young children have been found to be associated with narrative skills (Adams & Gathercole, 1996), utterance length and range of used syntactic constructions (Adams & Gathercole, 2000). Also, there is more than sufficient evidence that linguistic processing is constrained by general working memory capacity and effective utilization of that capacity (Moser, Fridriksson, & Healy, 2007). Moreover, there is a theoretical point of view that a deficit in verbal short-term memory abilities constrains the language development of children with SLI (Adams & Gathercole, 2000).

Based on previous research, Tallal (2004) concludes that there may be common underlying interactive neural substrates for language and nonverbal processing.

Present study

Although the use of behavioral measures of EF have been widely advocated to gain more ecological valid information, studies using rating scales of EF in children with SLI has been very limited. Obtaining information about the children's executive functioning through behavior ratings can be very useful for understanding how children's executive skills impact their activities of daily living. Also, there is a small body of literature about the effectiveness of working memory in everyday situations, while there are only a few such studies in population with SLI. Considering that, we wanted to examine behavioral aspect of working memory in children with SLI. Also, due to the importance of working memory for academic achievement, we wanted to examine the effectiveness of working memory in everyday situations in preschool and early school age SLI children.

METHOD

Participants

The sample consisted of 51 children with SLI, ages between five and eight years. All children were administered the Wechsler Intelligence Scale for Children Revised (Biro, 1997), and inclusion criterion was IQ above 85.

Table 1 and Table 2 provide descriptive data for the sample.

Table 1 – *Participants' age in months*

N	min	max	Mean	SD
51	58.00	100.00	73.69	11.65

Sample included 34 boys (66.70%) and 17 girls (33.30%).

The sample was subsequently divided into two age groups, a subgroup of preschool SLI children (≤ 72.00 months) and a subgroup of school age SLI children (≥ 73.00 months).

Table 2 – *Distribution of boys and girls in age subgroups*

Sex		Age		Total
		≤ 6 yrs.	≥ 7 yrs.	
Boys	N	15	19	24
	%	57.70%	76.00%	66.70%
Girls	N	11	6	17
	%	42.30%	24.00%	33.30%
Total	N	26	25	51
	%	50.98%	49.02%	100.0%

Instruments

For the purpose of an assessment of behavioral aspect of working memory, Behavior Rating Inventory of Executive function – BRIEF (Gioia et al., 2000) was used. The BRIEF Scale - Parent Form is a standardized questionnaire containing 86 items divided into eight subscales that assess 8 components of executive function (inhibition, shifting, emotional control, initiation, working memory, planning/organization, material organization and monitoring). The clinical scales form the two broader indices of behaviour regulation (BRI) and meta-cognition (MI), which are then combined into a Global Executive Composite (GEC). The puropse of this scale is to examine parents' perception of child's behavior related to executive abilities. Additionally, BRIEF scale provides a cutoff criterion for determining whether or not a given child's executive functioning ratings are sufficiently poor to be of clinical concern.

For the purposes of this study, the Working Memory subscale was used. Standard scores (T – scores) from the subscale were used for statistics. According to the norms, the average achievement limit is at the level of 50 standard scores. Standard scores between 50 and 65 (1.5 standard deviation above) correspond with underachievement, while achievement at the level of more than 65 standard scores are considered as poor achievement in the area of behavioral aspect of working memory.

RESULTS

Descriptive statistics showed that mean T – score for the whole sample is 57.82, ranging from 36 up to 85 (SD = 10.53). This results show that, as a group, SLI children are on the verge of underperformance.

Further, more detailed descriptive data give a better insight into distribution of children with normal achievement and those with poor performance. Descriptive indicators of normative deviation on the BRIEF working memory subscale in children with SLI are given in Table 3.

Table 3 – *Distribution of participants in relation to the threshold of typical achievement*

	N	%
< 65	37	72.50
≥ 65	14	27.50
Total	51	100.00

According to the norms, children who have T scores greater than 1.5 standard deviations above the cut-off value (T – score ≥ 65) have poor working memory performance. Data from the Table 3 shows that 27.5% of children with SLI have poor performance in the area of behavioral aspect of working memory.

Table 4 provides a detailed distribution of children with SLI on the BRIEF working memory subscale.

Table 4 - *Distribution of participants in relation to BRIEF achievement*

	N	%
normal achievement	26	51.00
1 sd	19	37.30
2 sd	5	9.80
3 sd	1	2.00
Total	51	100.00

Data from Table 4 show that 51% of children with SLI have good working memory performance. However, as many as 37.3% of children deviate by one standard deviation and are on the verge of underperformance, nearly 10% deviate by two standard deviations, while one child deviates even by three standard deviations. Initially, such data indicate that a number of children with SLI have some difficulties with behavioral performance of working memory.

By using ANOVA, we examined possible differences in achievement between boys and girls (Table 5).

Table 5 - *Sex differences in achievement on BRIEF working memory subscale*

sex		min	max	mean	SD	F	p
WM	boys	38.00	80.00	58.41	10.55	0.314	0.578
	girls	36.00	75.00	56.65	10.72		

WM – working memory

The results show that, relative to total sample, there are no significant differences in achievement between girls and boys. Although boys have a slightly higher T – scores, therefore worse performance, this difference is not statistically significant.

Additionally, we wanted to examine whether there are sex differences in the two subgroups, SLI children with good WM achievement and SLI children with poor WM achievement. Table 6 shows the distribution of boys and girls in SLI groups.

Table 6 – *Sex distribution in two SLI subgroups*

		< 65	≥ 65	total
Boys	N	25	9	34
	%	73.50	26.50	100.00
Girls	N	12	5	17
	%	70.60	29.40	100.00
Total	N	37	14	51
	%	72.50	27.50	100.00

By applying Chi – squared test, no significant differences were found in the number of boys and girls within the subgroups ($\chi^2 = 0.049$; df = 1; p = 0.824). These data show that boys and girls are relatively evenly represented in the different achievement categories, which further indicates that the level of working memory development in children with SJP is not sex related.

Further, using a two-factor analysis of variance, we examined the possible presence of sex-age interaction. Figure 1 shows the developmental tendencies of working memory in boys and girls.

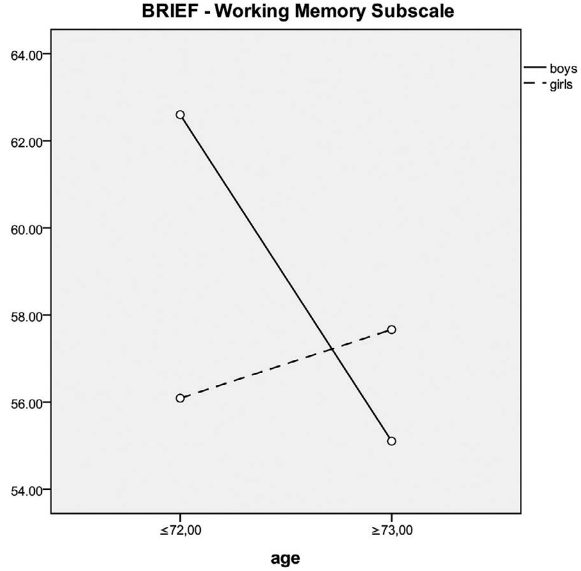

Figure 1 – Developmental trend of working memory in boys and girls with SLI

No interaction between sex and age was found ($F_{(1;50)} = 2.040$; p = 0.160), meaning that both, boys and girls exhibit a similar trend in working memory development. However, in Graph 1 it can be observed that school age girls have slightly worse achievements than preschool age girls (higher T – scores), while in the group of boys the opposite tendency is observed.

Accordingly, in the next step, we examined the sex distribution in two age groups, individually in group of children with normal achievement and group of children who deviate from the norms of average achievement (1, 2 and 3 SD above). Table 7 shows the sex distribution in age groups of children with normal achievement (26 subjects).

Table 7 – *Sex distribution in age subgroups in SLI children with normal achievement*

age		boys	girls	total
≤ 72.00	N	5	8	13
	%)	38.50	61.50	100.00
≥73.00	N	11	2	13
	%	84.60	15.40	100.00
	total	16	10	26

Chi – squared test revealed significant differences in the number of boys and girls within the subgroups ($\chi^2 = 5.850$; df = 1; p = 0.021). Such data indicate that in the younger group of children with SLI there are more girls who have average achievement, while in the older group there are more boys with average achievement.

On the other hand, in the group of children deviating by one, two or three standard deviations from the norms of average achievement (25 subjects), no significant difference in sex distribution was found between the age groups ($\chi^2 = 0.326$; df = 1; p = 0.450). Such data indicate that the representation of girls and boys does not differ significantly in the group of children with borderline and poor achievement.

DISCUSSION

Although SLI has been defined as a language disorder in the absence of neurological, intellectual, or physical impairments, evidence is accumulating suggesting that children with SLI also manifest difficulties with executive functioning. Problems with executive functioning are especially obvious in the area of working memory (Archibald & Gathercole, 2006; Montgomery & Evans, 2009). This has led to one view that memory limitations may underlie some of the language difficulties that can be seen in these children (Montgomery 2003).

Descriptive analysis in our research showed that in overall, SLI children are on the verge of underperformance. However, a number of SLI children (27.5%) in our sample have poor performance in the domain of behavioral aspect of working memory. Given that a percentage of 5% would be expected in a normal distribution (Cuperus, Vugs, Scheper, & Hendriks, 2014), we can say there is significant number of SLI children having clinically impaired range of WM performance in everyday situations. There is a body of research suggesting that children with SLI exhibit low performance on WM tasks in clinical settings (e.g. Adams & Gathercole, 2000; Archibald & Gathercole, 2006; Van Daal et al., 2008). On the other hand, there are only few studies addressing the impact of WM on daily life activities in different contexts in SLI children. In one such study of Cuperus et al., (2014), results showed similar distribution like in ours, whereas average T–score was in the range of borderline achievement (M = 52) with 12% of SLI children who had poor WM performance. Comparing to Cuperus et al., (2014) study, SLI children from our sample have slightly worse achievements (58 average T–score and 27% with poor performance). This can be explained with overall clinical heterogeneity in SLI population. This variability and heterogeneity increases in everyday performance of language skills and associated difficulties in children with SLI. Moreover, some aspects of executive abilities in children predict later vocabulary development and literacy (McClelland et al. 2007), which can make mustering academic skills even harder for children with SLI.

In one another study, Wittke and colleagues (2013) were examining overall executive functions of children aged 3–5 years using the BRIEF preschool version. They found that the behavioral aspect of executive functions in children with SLI was rated significantly worse than those of their TD peers. However, it is difficult to compare our results with the mentioned study (Wittke, Spaulding, & Schechtman, 2013) because of different methodology and aim of study. Namely, the aim of the aforementioned paper was to compare composite scores of executive functions obtained from parents and teachers, in children with SLI and their TD peers. On the other hand, we considered only scores from the Working Memory subscale, comparing the achievements of children with SLI and TD children. However, both, the results of Wittke and colleagues (2013) study and the results of our study, indicate significant difficulties in the functioning of executive abilities in children with SLI.

As BRIEF scale offers a view of children's executive function profiles in context, our data showed that there are number of children with SLI who are at risk for certain patterns of executive difficulty. Also, our findings further support the idea that many children with SLI have deficits beyond the language domain. More research is needed to investigate which children with SLI are at specific risk for working memory deficits. Also, more research about relations between specific language abilities and WM performance is needed.

Regarding sex differences, initially we did not find differences. However, a more detailed analysis revealed some specifics. Results showed that in the younger group of children with SLI (5 and 6 yrs.) there are more girls who have average achievement, while in the older group (7 and 8 yrs.) there are more boys with average achievement. This indicates the possibility that with maturing SLI boys have better behavioral aspects of working memory, comparing to girls. This can be explained with sex differences during development of working memory in typically developing children. Namely, at an earlier age (4–6 years) there are no significant differences between typically developing boys and girls in terms of working memory. On the other hand, boys exhibit significantly better working memory at the age of 6 to 16 years (Lynn & Irwing, 2008). However, more detailed research on sex differences in working memory found that girls performed better on verbal working memory tasks, while boys performed significantly better on visuospatial working memory tasks (Lowe, Mayfield, & Reynolds, 2003). There is no data in the literature regarding sex differences in the behavioral aspect of working memory, and studies to date have examined only achievement differences exhibited during direct assessment. Accordingly, one of implication for future research goes in this direction. However, we must note that the number of boys and girls in our sample is unequal (more boys), and therefore we cannot draw reliable conclusions regarding sex differences. Given that SLI is a disorder that is significantly more prevalent in boys, it is difficult to equal gender distribution in this population. However, a significantly larger sample in a future studies would reduce the effect of this prevalence, allowing a more reliable examination of sex differences in children with SLI regarding everyday working memory performance.

CONCLUSION

Results of our study showed that a significant number of children with specific language impairment have difficulties in the area of behavioral aspect of working memory. These findings add to a growing body of evidence indicating that children with SLI exhibit working memory deficits and provide evidence that such difficulties manifest in everyday living. Children with SLI have already significant difficulties in academic achievement due to language difficulties, so difficulties in the area of cognitive abilities can make process of mastering academic skills even harder for these children. Accordingly, results of our study indicate the need for more extensive assessment of these children in preschool period.

Also, some developmental sex differences regarding behavioral aspect of working memory were observed. However, more detailed methodology is needed in future studies for reliable conclusions.

Also, future studies in this area should investigate the precise association between the behavioral aspect of working memory and the specific linguistic difficulties present in children with SLI. At the end, important issue should be focused to interventions/strategies that target executive abilities in natural context with SLI children.

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ANALYSIS OF PRAGMATIC ABILITIES IN SCHOOL CHILDREN

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SUMMARY

Communicative functions are abstract units that reflect the speaker's communicative intent. They involve motivation, aims and objectives that one wishes to achieve by communicating with other. Conversational abilities refer to the subject's capacity for participating on an interactive sequence of speech acts which aims the communicative interchange. Pragmatic language ability refers to the ability to use language in a social context. Methods: participants of this study were 40 children, with ages between 7 and 12 years, who attended primary school. The aim of this research was to investigate pragmatic ability in school age children and to compare pragmatic abilities in relation to age, intelligence and social experience. For testing, we used the Test of Pragmatic Language-TOPL (Diana Phelps -Terasaki & Phelps-Gunn Trisha). Results: The results showed that the intelligence quotient is directly related to the achievements of the pragmatic language test, there are significant differences in the achievements of children in relation to the education of their parents too. Conclusion: these results confirm the assumption of intelligence as basic ability and relatively reliable predictive factor in the development of pragmatic skills as well as the children whose parents have higher education have more stimulating speech and language backgrounds and diverse cultural-sociological models of communication.

Key words: Children, pragmatic abilities, communication, language development

INTRODUCTION

Children vary in their ability to use language in social contexts and this has important consequences for wellbeing (Matthews, 2018). The main function of a language, which was defined by Ferdinand de Saussure, is the communicative function. There is constant interaction of language and social context. Since its birth, the child is surrounded by speech, mainly by speech that adults refer to each other or to the child, which means not monologue but dialogue. In the frame of very complicated social interaction, which can be verbal or nonverbal, the child begins to develop communicative skills. Child is confronted with a very complex task: on the one hand to take control of the language system, to develop linguistic ability, competency and on the other hand through social interaction to get involved in acquiring communicative competency. The child from the earliest period of life tends to master linguistic and sociolinguistic rules (Jocić, 2006). Sociolinguistic approach to the study of language has led to the emergence of new terms or new meanings of communicative competence of the speaker and the listener. Emphasizing the need to access the language in which socio-cultural factors have an explicit and constitutional role, linguist Del Hymes created the term communicative competence. Such competence are important in adult–child relations, qualifying children as interactional competent students in educational settings, and play a significant role in shaping children's written literacy skills.

Apart from learning the structure and the meaning of its mother tongue, a child must learn the terms of use of that particular language and verbal behaviour. In contrast to the Chomsky's competence of generative grammar, Hymes's social linguistic term has a broader meaning: it includes both, linguistic and sociological aspects, as to it refers to the knowledge of the structure and rules of a language and also to the awareness of using those rules in speaking and understanding, the rules of use without which grammatical rules would be useless (Jocić, 2006). Chomsky sharply separates basic language ability (competence) from its concrete manifestation in speech activities (performance). Fundamental and quite a sharp distinction between language skills and speech activities and the theoretical primacy of the first are important definitions of generative grammar in its present form. Original terms that were introduced by Chomsky are competence and performance. Alternative terminological opposition in the Serbian language could be knowledge - demonstration. It is important to understand that the ability is not a skill, because it would then be in the range of active.

Under the ability, on the contrary, it is essential to understand the power of producing and understanding of the statement in the native language that the speaker, possesses where the ability in short means what someone knows, even if it is largely unconsciously and the activity is what he does with it. Speaking activity (the use of language in communication) is the direct response of language ability (the knowledge of the language that the speaker-listener possesses). In order to study the speaking activity we should consider the combined effects of a whole variety of factors, amongst the language, ability of speaker-listener, etc. Children's communicative use of language allows them to respond to and to solicit further speech, thus organizing social interaction as adjacent responsive and reactive verbal actions that serve as the building blocks of conversation and inter subjectivity.

Communication and Language competence

Humans make relatively rapid progress in developing acquiring and building up the intellectual and creative abilities thanks to linguistic abilities, i.e. privilege to be able to possess, develop, and use such a perfect tool for communication as language is. Language ability is manifested in two forms. The first is a system of units and rules, which the representatives of a group must master in order to be able to communicate with each other (to communicate through language). This kind of manifestation of general language abilities can be called linguistic knowledge or language competency. Knowledge of a language cannot be inherited, therefore it is not congenital, congenital is only the language ability, and in other words congenital are predispositions for language. Language knowledge means, knowing the units of the language on all levels, but also knowing the rules for combining the language units. However we should not forget (but it is often forgotten) that the language would not work if it does not include the rules of selection and rules of language use due to the situational context. Therefore, there are two types of linguistic knowledge or language skills a) knowledge competencies code (language system) and b) the knowledge, communication skills (implementation, using the language system). The second round of general expression of language skills is the use of language, i.e. use of linguistic knowledge or linguistic competence.

Language is one of the determining factors of general development of the child and as such, it is often the subject of scientific studies. It is very hard to mark off biological, logistic, psychological, social anthropological course in studying speech and language development. Interdisciplinary is the approach, which connects recent theoretical and research orientation. This conception is particularly present in pragmatic development (Barriga Villanueva, Ninio, & Snow 1996). Developmental pragmatics in this section is interpreted as a field of study lying (placed) between linguistics and the social development without sharply defined borders. In this part, the pragmatic development is understood as a heterogeneous area. These authors agree with Vygotsky's theoretical orientation, by which speech and language are developed in communication. The theoretical basis from which above mentioned authors start is the interactive contextually oriented model of behaviour and development of speech in which the child is seen not only as a passive receiver from the outside but also as an active one in interpersonal meeting at which the meaning of behaviour is constructed by the (Barriga Villanueva et al., 1996). For Luria, child's communication with adults is the elementary form of living activity in which the whole child's development takes place.

The development of communication is a process of interchanging quality-specific forms of communicative activity. That process has its motives, needs, specific operations and communication. The motivation to understand self and others takes different forms with different goals at the various stages of development. At each stage of development the content of communication that attracts a child to an adult changes in such a way that it provides the child with sustained adult attention (Grigorenko et al. 1997). This attention is necessary for a child to be able to solve tasks specific for his age. Lisina described for stages in the development of children's communication:

1. The need for adults attention and benevolence (from two to six months of age).
2. The need for joint activity and adults participation (from six months to three years of age).
3. The need for respect (from three years to six years of age).
4. The need for understanding and shared experience (from five to seven years of age).

This author thinks that main importance in development is situational practical communication because it is interposed by actions of language development. The development of communication (in ontogenetically sense) is started by effectual, through practical-situational, till symbolical or semiotic (Ivić, 1994). The child starts contact with its social environment first with nonverbal signs (smiles, cooing crying). The adults receive, understand and react to those signs. Based on effectual, dialectical communication adult-child (the language of sentiments), and the practical-situational, nonverbal communication (the language of actions) is developed through mutual activity of the adult and the child. Through these phases, the adults use the language, which is cut for a child, simple words, and combination of words, slow-paced speech, and a lot of repetition (speaking to a child is highly redundant). Adult speech is a translation of action into verbal plan, which allows the child gradually to learn the meaning of the words. Socially- affective relations and joint activities of children and adults are the foundation of all subsequent forms of communication (Gopnik, Meltzoff, & Kuhl, 2003). Language development is the result of the integrated developed achievements in three different areas: conceptual, linguistic and social.

Pragmatic competence

Pragmatic ability can be defined as a part of communicative competence. Linguistic competence refers to the use of language in phonology, morphology, syntaxes and semantics as in receiving (the coming information, which can be heard, or read) also in expressing spoken or written information. For example, a person can show linguistic ability to use different forms that are semantically and syntactically correct, but that person does not identify the right moment when those construction should be used in a most efficient and most acceptable way. On the other hand, communicative competence includes pragmatically knowledge and consciousness when in the most efficient are certain linguistic constructions used. Linguistic/language competence refers to the language through phonology morphology syntax semantics but it does not refer to the pragmatics dimension of the language. Accurate use of formal syntactic structures and semantics do not always provide good communication, because the communication should take into account situational, social and linguistic context. Bishop (2001) emphasise that language ability is necessary condition for communicative competence, but not the only one. Children, even when they do not fully understand the language, rely on contextual and non-verbal elements in order to understand the intention of interlocutor (Ivšac & Gacina, 2006). Understanding of our own intentions and also the intentions of an interlocutor is explained by social cognition whose importance for conversation and communication is advocated by numerous authors (Bishop, 2002).

In pragmatic studies, definitions of pragmatics and study frameworks vary quite widely, which may be due to the multidisciplinary nature of pragmatics. According to the American Speech and Hearing Association (American Speech and Hearing Association – ASHA, 2005) the pragmatics of the language used in social interactions includes three communication skills. The first one is the use of language for different purposes such as greetings, giving information, asking for information, requests, and promises. The second one is adjusting the language to the requirements of the situation or interlocutor (we address in a different way a child as compared to an adult, we give enough information to someone who is under-informed, a place where we are also affect our communication). The third one is the respect of the rules of conversation (rules relating to the exchange in the conversation, stick to the topic primarily initiated, introduction of new topics of conversation, behaviour during misunderstandings). There are rules for using nonverbal signs in communication such as: the distance between the interlocutors, facial expressions, and eye contact. The rules are determined by particular culture and language. Pragmatics relates to the study of meaning as communicated by a speaker - pragmatics analyses what people mean under the expression they use rather than what the words or phrases in those expressions might mean by themselves. Pragmatics studies the contextual meaning - in other words, how a speaker organizes what he/she wants to say in accordance with whom he/she is talking to, where, when and under what circumstances. Pragmatics studies how the context affects what is said. Pragmatics studies the invisible meaning, in other words, it explores how more is communicated than it is said - how a great deal of what is unsaid is recognized as part of what is communicated. Pragmatics deals with relative distance, concerning closeness (physical, social, conceptual). Depending on how close the listener is, the speaker determines how much is needed to be said. Great lack of research and evaluation of pragmatics itself is the inability of an objective and consistent analysis of its concepts (Yule, 2002). Pragmatic ability can be defined as communicative competence. Linguistic competence refers to the use of language in phonology, morphology, syntaxes and semantics both in receiving (the information received, which can be heard, or read) and in expressing spoken or written information. For example, a person can show linguistic ability to use different forms that are semantically and syntactically correct, but this person does not identify the right moment when such syntax should be used in the most efficient and most acceptable way. On the other hand, communicative competence includes pragmatic knowledge and awareness of the best time for the most efficient use of certain syntax constructions. Cognitive knowledge, linguistic knowledge, and social knowledge in the interaction are prerequisites of effective communication. Communicative competence depends on many skill, factors, abilities, the overlapping factors, and they are often abstract. Linguistic/language competence refers to the language, i.e. phonology, morphology, syntaxes, semantics, however, it does not refer to the pragmatic dimension of the language. Accurate use of formal syntax and semantics do not always provide good communication, because the communication should take into account situational, social and linguistic context. Communicative competence refers to the use of social rules of language and includes the pragmatic knowledge and awareness. The development of a certain level of a language system, preserved processing system with access to a rich knowledge base, ability to understand and analyze the thoughts and actions of other people are the prerequisites for the development and implementation of pragmatic competence. Bishop (2001) emphasizes that language ability is necessary condition for communicative competence, but not the only one. Children, even when they do not understand the language completely, rely on contextual and non-verbal elements in order to understand the intention of interlocutor. Pragmatic ability involves the development of language system, cognitive development, memory capacity, reasoning ability, integration of information while following the intention of the interlocutor, prior knowledge about the world (experience) (Van der Lely, 2003).

Pragmatics refers to how to language is used in context to a range of purposes. Pragmatics is constrained by sets of rules, like other levels of language. There are rules how to initiate, regulate and terminate conversations.

The development of pragmatic ability

The study of child pragmatic development is a heterogeneous field that brings together linguistic pragmatics and child development, and encompasses different traditions and theoretical perspectives on language and social interaction.

The earliest children’s language activity is speech act. Already in the first year of age before the appearance of the first word children use intonational forms. With ten months children show by hand what they want, they express intentions by gesture, and later they verbally express such intentions. When the child utters his first words he already has intonational forms by which he carries out intentions (positive and negative feelings, identification of objects, requests, statements). These acts are carried out in direct context. By the age of three children use statements, in other words requests in imperative mood (Give juice). Between the age of three and six, the children use less direct forms. (May I have the juice). At the age of six the children develop and use indirect speech acts (Delahunty & Garvey, 1997). Basic conversation, taking the role of listener and speaker appears very early, at the age of three months. When a mother speaks to the child, the child turns his head and replies by intonation, by facial expression and vocalisation. The child even understands when the speech is not addressed to him. Through the period of two words stage, expectations are raised to the level of verbal response. Mother gives the child conversational support through the following models:

a) dialogue (M-where is the ball?, C-raises ball, M- there is the ball),
b) expanding (C-rabbit, M-rabbit likes to eat salad, will you give him a little?),
c) encouragement (M-what did you see?, C-silence, M- you saw what?).

Introduction and development of the topic is possible only if the topic relates to the familiar objects and events and is encouraged by adults. Children at the age of three with their peers rarely start the topic, if they start the choice is random and the change of topic is common (Delahunty & Garvey, 1997). Children between the second and fifth year in taking over the role of speaker and listener make a long pause. Coherence, in other words logical connection between statements from the one that proceeded is in connection with the cohesive markers or aids (anaforcial replacement, noun, ellipsis conjunction, repetition, and substitution). The most significant increase in the use of this form is at the age of five. Child's ability to tell the story develops at the age of three. The stories are simple, involving the personal experience, with very little information, but with characters, events and actions. Reasoning ability is developed only at the age of five, six and seven. At the age of eight and nine children develop the ability of the transferred meaning, this ability appears much earlier, at the age of three, but the meanings are related to the physical quality (e.g. high as an elephant). Over time, children learn the lexicocommunicative and pragmatic means that enable full verbal and situational sensitive realization of previously acquired communicative intents such as justifications, promises, prohibitions, challenges, apologies, explanations, refusals, and disagreements. Approximately from the age of seven children develop a wide repertoire of creative interactive language activities, learn jokes, riddles, to insult one another, to maintain group identity. Studies on the conversations of young children show that many interactive capabilities are already present before starting school.

METHOD

The subject of this research is pragmatic ability in children in primary school. The aim of the research is to investigate pragmatic ability in children and to compare pragmatic abilities in relation to age, intelligence and social experience. The hypothesis of this research is based on that pragmatic ability depends on intelligence, age and social experience.

Sample and Instrument

The sample consisted of 40 school children, 7 to 12 years old, who attend primary school Cyril and Methodius in Belgrade. Only children with IQ- 90 and over 90 are included in the sample (the data on IQ are from the database of the school psychologist). Children were individually tested. For the testing, we used the Test of Pragmatic Language-TOPL (Diana Phelps-Terasaki & Phelps-Gunn Trisha). TOPL consists of 44 questions which the examiner asks (reads), and the examinee answers to them. There are pictures for all items (44). Narratives and story contexts revolve around natural every-day communicative and social interactions. The main objective of this test is to use a comprehensive understanding of the pragmatics or social language skills on the tested population. Test items were grouped into six core components of pragmatic abilities: physical setting, audience, topics, purpose (speech act), visual-gestural cues, and abstraction. The basis of this research is descriptive method and correlation analysis.

Statistical methods

The basis of this research is descriptive method and correlation analysis. Statistical parameter and nonparametric methods were used. The statistical data processing used the following statistical measures and procedures: frequencies and percentages, ratings, arithmetic mean, standard deviation, chi-square and its significance, Pearson's linear correlation coefficient and its significance.

RESULTS

Children's achievements on the test assessing pragmatic abilities were expressed in three forms: raw score, percentage, age equivalent.

Table 1. *Results on the Test of Pragmatic Language*

Pragmatic	**M**	**Std**	**Min**	**Max**
raw score	35.67	4.576	30	44
%	**54.95**	28.408	11	96
age equivalent	**8**	3.370	1	11

Legend: 1-results at the age level; 8-results above the age level, 6 months higher; 11-results above the age level, 24 months higher

The *Table 1* shows that this age children in primary school, on average, successfully solve 54.95% of the test. The raw score was 35.67 (possible maximum 44). As regards the minimum and maximum achievements, there are children who had the maximum number of points - 44 - on the test. As regards age equivalents, pragmatic ability of children in primary school is above average, equivalent to the children who are 6 months older.

Table 2. *Results of the Test of Pragmatic Language / components*

Components	N	M	Std	Min	Max
physical setting	40	8.88	0.335	8	9
Audience	40	9.08	0.997	7	10
Topics	40	6.78	1.097	4	8
speech act	40	6.50	1.155	4	8
visual-gestural cues	40	3.13	1.925	0	6
Abstraction	40	1.35	0.864	0	3

Table 2 shows the results of primary school children's achievements for each component individually. With regard to the lowest achievements at two sub-tests, abstraction and visual-gestural cues were the hardest for children of this sample (there are children that did not win a single point). The children made the best results at first and second sub-tests, physical setting and audience, which is indicated by high average achievements and low standard deviations (*Table 2*).

Intelligence

The lowest intelligence quotient is 90, and the highest is 125. The average intelligence quotient is 104.58. We formed three groups of children in relation to intelligence (1st group: IQ 90-100; 2nd: IQ 101-110 and 3rd: IQ 111-125). The lowest achievements on the pragmatic language test have children from the first group, i.e. children with IQ of 90-100.

Table 3. *IQ and achievement on the Test of Pragmatic Language / components*

Components	IQ	N	Mean Rank
Physical setting	1.group	15	16.33
	2.group	11	23.00
	3.group	14	23.00
Audience	1.group	15	13.90
	2.group	11	20.09
	3.group	14	27.89
Topics	1.group	15	14.13
	2.group	11	19.32
	3.group	14	28.25
Speech act	1.group	15	15.60
	2.group	11	17.09
	3.group	14	28.43
Vsual-gestural cues	1.group	15	13.07
	2.group	11	18.55
	3.group	14	30.00
Abstraction	1.group	15	17.07
	2.group	11	18.55
	3.group	14	25.71

Table 4. *Statistical significance*

	Physical setting	Audience	Topics	Speech act	Visual-gestural cues	Abstraction
h^2	9.243	11.342	11.192	10.599	16.593	5.138
df	2	2	2	2	2	2
p	0.010	0.003	0.004	0.005	0.000	0.077

In this research, intelligence has proved to be an important factor of pragmatic competence. Table 4 indicates that IQ is important for all examined pragmatic language components, particularly for visual-gestural cues ($p < 0,001$; $h^2 = 16,593$), audience, topics, speech act.

The results show that the difference between the three groups is statistically significant. Achievements on the pragmatic language test are directly related to IQ. The level of intellectual functioning observed by intelligence quotient (IQ) of children examined proved to be a significant factor in all the examined variables. Children who are functioning at a higher intellectual level achieved significantly better results in all the investigated variables. The results showed that the intelligence quotient is directly related to the achievements of the pragmatic language test, namely, children from the third category, i.e. children with intelligence of 111-125 have the best achievements in all tested variables. We can conclude that these results confirm the assumption of intelligence as basic ability and relatively reliable predictive factor in the development of pragmatic abilities.

Age / Grades

Table 5. *Grades and achievement on the Test of Pragmatic Language*

Grades	M	Std	N
2.	67.40%	22.107	10
3.	41.40%	27.897	10
4.	61.70%	32.738	10
5.	49.30%	26.382	10
N	54.95%	28.408	40

Chi-Square 24.097, p = 0.002

Table 6. *Results achieved at the Test of Pragmatic Language, expressed in coefficients*

age		**Coefficient**			
		High	above average	average	below average
7	%	33.3	33.3	33.3	0
8	%	0	50.0	55.0	0
9	%	11.8	17.6	23.5	47.1
10	%	25.0	0	50.0	25.0
11	%	0	0	66.7	33.3
12	%	0	100	0	0
N	%	10.0	25.0	37.5	27.5

Table 6 shows the results achieved by the children aged 7 to 12. Seven-year old children are equally divided on the basis of their results in three categories (with high, average and above average results, each group containing about 33% of the children). What needs to be emphasised is that not a single child aged seven, eight and twelve had the results above average at the pragmatic language test. The majority of children who, according to their results, belong to the group of children below average, are nine-year old children (47%), then eleven-year old children (33.3%) and ten-year old children (25%). If we consider the results for the whole sample, then we may conclude that the majority of the children aged seven to twelve have achieved average results at the pragmatic language test (37.5%). The number of children with the results above average and below average is almost equal.

Parent education

Social experience of the child we watched through parent education. In this study better results on the Test of pragmatic Language to children whose parents have a higher education level. It is concluded that education of parents, is an important factor in child's pragmatic skill.

Table 7. *Test results on the pragmatic language and the education of parents*

Pragmatic	**Group**	**average rank**	**Mann Whitney U**	**p**
raw score	Secondary School degree	15.02	50.500	**0.000**
	University degree	29.63		
%	Secondary School degree	15.02	50.500	**0.000**
	University degree	29.63		
age equivalent	Secondary School degree	17.68	117.000	**0.034**
	University degree	25.20		

The socio-educational status of parents is assessed in this research. The results showed that there are significant differences in the achievements of children in relation to the education of their parents. The differences are significant on all scales and subscale (the majority of them is a level of significance of 0.001). Our research has shown that education of the mother is a very important factor in semantic and pragmatic skills of the child. The same showed for the education of the father.

DISCUSSION AND CONCLUSIONS

Understanding a child's communication is one step towards understanding them as a whole child. Linguistic skills alone are not enough for successful communication. In communicative situations, listeners need to work out the meaning of a linguistic expression on the basis of the contextual factors of the situation and on the basis of their world knowledge and experiences (Leinonen & Tandefelt, 2007). Ability to answer pragmatically demanding questions is dependent on many developmental factors. However, because of the complex nature of communication, it is not possible to represent all factors affecting communication, which is why the focus here is only on some of the basic factors. Sensory-motorical functions such as auditive and visual perception and articulatory ability make a ground for communication. Linguistic ability makes it possible to understand linguistic information that is uttered and formulate a verbal answer. Therefore, children's question answering is connected with their ability to deal with the linguistic structure of questions and ability to understand the meanings of words. However, in everyday communication situations linguistic skills are not enough since without cognitive abilities necessary for pragmatic understanding, utterance interpretation remains problematic.

The results showed that the intelligence quotient is directly related to the achievements of the pragmatic language test, children with intelligence of 111-125 have the best achievements. We can conclude that these results confirm the assumption of intelligence as basic ability and relatively reliable predictive factor in the development of pragmatic abilities. As regards the school age achievements, pragmatic language test does not indicate a continuous and a clear correlation of these two variables. School age has not proved as a significant factor when examining the pragmatic skills. There is a rise in achievements in the pragmatic language test of school children according to the increase of their school-age, but still we cannot talk about a stable and strong tendency.

The socio-educational status of parents is assessed in this study. The results showed that there are significant differences in the achievements of children in relation to the education of their parents. The differences are significant. Results showed that parent's education is an important factor in pragmatics ability. Our research has shown that education of mother is a very important factor in pragmatic ability of her child. The same has been noticed for the education of the father. These results are quite expected since the beginning of conversation occurs very early in the first mother-infant relation. Dore defined four types of communication relations that are important for conversational development: a) mother-child relationship, b) relationship with younger brother or sister, c) relationship with peers and d) pupil status relations. The interpretation of the results obtained in such manner will base on already presented view that biological factors determine the extent of possibility or impossibility, therefore, the limits outside which development is hard to imagine, and the social environment is responsible for realisation of the potential. As intelligence is at least partly dependant on heredity, it is logical that children of more educated parents and presumably more intelligent are themselves, more intelligent. Educated parents usually have high aspirations. In addition, they belong to higher socio-economic class of society so they are able to provide children with the necessary incentives for the full recognition of cognitive potential. It is likely that children whose parents have higher education, presumably of higher socio-economic class, have more stimulating speech and language backgrounds and diverse cultural-sociological models of communication.

Inference can be seen as a cognitive process to connect information from different sources. It is an especially important ability when deriving an implied meaning of an utterance, as shown by studies about text comprehension in children (Cain, 2001). Pragmatic ability is a developmentally long process to become fully aware of one's own processing in different situations and to be able to give a verbal explanation when it is asked for (Ryder & Leinonen, 2014).

The level of intellectual functioning observed in the study of intelligence quotient of children proved to be a significant factor in all the examined variables. We can conclude that these results confirm the assumption of intelligence as basic ability and relatively reliable predictive factor in the development of pragmatic skills. Observed through school age achievements pragmatic language test does not indicate a continuous and a clear correlation of these two variables. There is a rise in achievements in the pragmatic language test in children with dysgraphia language according to the increase of their school-age, but still cannot talk about a stable and strong tendency. Results showed that parent's education is an important factor in semantic and pragmatics skills. It is likely that children whose parents have higher education, we assume the higher socio-economic class have more stimulating speech and language backgrounds and diverse cultural-sociological models of communication.

Development of the language, communication and speech systems are depended on each other and inextricably interwoven into a child's general development. Knowledge of the rules that exist in speech, language and communication is implicit in children acquiring the language and in mature speakers (Buckley 2003).

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A LITERATURE REVIEW ON TECHNIQUES OF TREATING PEOPLE WITH AUTISM SPECTRUM DISORDER DURING DENTAL PROCEDURES

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SUMMARY

It was noted that parents frequently avoid taking their child with autism spectrum disorder (ASD) for routine examinations, because of the children's fear of dental procedures, or difficulties in locating a practitioner willing to provide care, or specialized to treat such individuals.

The aim of this paper is to recognize obstacles that patients with ASD and their caregivers incounter in getting dental care, as well as to present different techniques that can be used in dental setting in order to help people with ASD overcome those obstacles.

The Serbian Library Consortium for Coordinated Acquisition–KoBSON, as well as Google Scholar Advanced Search were used when reviewing the literature.

By reviewing the literature, the main obstacles were stated to be individual characteristics of people with ASD and lack of dental staff training in treating people with ASD.

Tecniques that can be used to improve dental care of patients with ASD are minimized sensory stimulation, short visits to the dental clinic and minimized wait time, several rehearsals in a mock environment, as well as working with the same dentist. Behavioural strategies can also be used, electronic screen, visual supports, or Picture Exchange Communication System. If all of the above does not give results, dental treatment can be provided under general anesthesia or physical restraint.

In conclusion, we give recomendations for University school of dentistry to involve treating people with ASD in their practical aspects of studies, as well as educate prospecting students in using some of the stated techniques.

Key words: autism spectrum disorder, dental care, techniques

INTRODUCTION

There are so many definitions used to describe autism spectrum disorder (ASD), but the majority of authors agree that autism spectrum disorder is a life-long neurodevelopmental disorder characterized by qualitative abnormalities in reciprocal social interactions and patterns of communication, and by a restricted, stereotyped, repetitive repertoire of interests and activities (Barbaresi, Katusic, & Voigt, 2006; Dover & Lecoteur, 2007; Friedlander, Yagiela, Paterno, & Mahler, 2006). It has been reported in many studies that the male to female ratio is 4:1 with more severe symptoms exhibited in females (Klein, 1998; Medina et al., 2003).

The diagnosis of ASD is based on 4 criteria (Barbaresi et al., 2006; Rapin & Tuchman, 2008; Spence, Sharifi, & Wiznitzer, 2004): serious alterations in social relations; serious alterations in the development of communication; patterns of behavior, interests and activities that are restricted, repetitive, and stereotyped; and early onset, before 3-5 years of age. Boulet et al., (2009) reported that intellectual disability is frequent in people with ASD, having an estimated prevalence of 75% (Rapin & Tuchman, 2008; Spence et al., 2004). Behavioural disturbances associated with ASD include self-injurious behaviour, aggression, temper tantrums, psychiatric symptoms and pica (Friedlander et al., 2006; McAdam, Sherman, Sheldon, & Napolitano, 2004), as well as uneven intellectual development, peculiar repetitive body movements, hyperactivity, limited attention span and a low frustration tolerance, that may lead to temper tantrums or bizarre vocalization (Kamen & Skier, 1985). Even if small changes in their daily routine are made, temper tantrums may easily be provoked (Burkart, 1984; Wedel, McKown, Sanders, 1994).

ASD may also be associated with unusual responses to sensory stimuli, such as oversensitivity to unfamiliar sounds, touch, and heightened reactions to light (DSM-IV, 2000), but they can also have hyposensitivity to a pain stimuli (Mauk, 1993; Tuchman & Rapin, 1991).

Verbal and non-verbal communication tends to be limited or non-existent and aproximately 50% of patients do not acquire spoken language. Their language is often repetitive and does not correspond to context, demonstrating lack of comprehension (Whitehouse, Barry, & Bishop, 2008).

It has been well documented that many children with ASD exhibit fears of unknown origin (Howlin et al., 1973; Jackson & King, 1982; Love, Matson, & West, 1990; Luiselli, 1978) and these fears may be related to the difficulty of dealing with visual and auditory stimuli (Hemsley, 1978). Therefore, patients with ASD are at an increased risk for many systemic conditions (Volkmar, Klin, Schultz, & State, 2005).

Nowak, Casamassimo and Slayton (2010) stated that locating practitioners who are capable of providing care for patients with ASD is especially difficult, and Kopel (1977) indicates that this problem occurs because practitioners find it time-consuming. However, approximately 60% of dentists said they offer special arrangements for children with ASD, but only 8% said they have a special office setup for these patients (Weil & Inglehart, 2010).

The aim of this paper is to recognize obstacles that patients with ASD and their caregivers incounter in getting dental care, as well as to present different techniques that can be used in dental setting in order to help people with ASD overcome those obstacles.

METHOD

The Serbian Library Consortium for Coordinated Acquisition–KoBSON, as well as Google Scholar Advanced Search were used when reviewing the literature. The literature was searched using the keywords: autism spectrum disorder, dental care for patients with ASD, techniques used in dental care of patients with ASD, obstacles in dental care for patients with ASD.

Difficulties in dental setting for people with autism spectrum disorder

Children with ASD are more likely to have a variety of medical and psychiatric conditions requiring frequent physician visits for preventive, non-emergency and emergency care and are on high medication usage (Gurney at al., 2006). Studies show that dental care remained the most prevalent unmet healthcare need for this population (Iida & Lewis, 2012; Lewis, 2009; Lewis et al., 2005) and as far as 25 % of parents experienced difficulty in accessing dental care for their child with ASD (Marshall et al., 2010). Estrella (2013) emphasises that some parents may be reluctant to communicate their concerns in view of difficult experiences they have encountered accessing other services.

Many children with ASD have poorer oral health than neurotypical children (Brickhouse et al., 2009; Kopycka-Kedzierawski & Auinger 2008; Nelson et al., 2011) and high prevalence of dental trauma (Du et al., 2015), therefore they have a lower hygiene level (Lowe & Lindemann, 1985) and greater prevalence of dental disease (Bloom, Cohen & Freeman, 2011; Surgeon General, 2000; Committee of Oral Health, 2011).

Some authors claim they do not possess the manual dexterity to perform effective tooth-brushing (Lowe & Lindermann, 1985), others claim that dislike of the toothpaste taste, as well as the feeling of the toothbrush may compromise the effectiveness in removing the dental plaque (Stein, Polido, Mailloux, Coleman, & Cermak, 2011). Also, young and non-institutionalized patients with ASD are said to have better oral hygiene than those who are institutionalized, because home-stay patients have their parents to brush their teeth and young children were easier to manage, because of their smaller body size (Lowe & Lindermann, 1985). Also, there is a significant role between the parents' dental hygiene and childrens' oral health (Barker & Horton, 2008).

It was noted that parents frequently avoid taking their child with ASD for routine examinations because of the children's fear of dental procedures (Howlin & Rutter, 1987; LaCamara & LaCamara, 1987; Luscre & Center, 1996), or difficulties in locating a practitioner willing to provide care (Nelson at al., 2011), or due to the difficulty to locate a dentist specialized to treat such individuals (DeMattei, Cuvo, & Maurizio, 2007; Glassman at al., 2005; National institute of Dental and Craniofacioal Research, 2009). On the other hand, pediatric and general dentists reported that they received little or no training in their predoctoral dental education in treating patients with ASD (Weil & Inglehart 2010), which explains their unwillingness to provide this kind of necessary care to persons with ASD (Siegal, 1985). Wolff et al., (2004) reported similar findings: 50,8% of dental students had no clinical experience in caring for patient with ASD or related intellectual/developmental disabilities, and 60% reported having little or no confidence in providing care to this population. The main challenge to the dental team may be the reduced ability of these patients to communicate and relate to others (Kamen & Skier, 1985; Kasahara, 1985). Therefore, it has been reported that as low as 10% of practitioners treated children with disabilities on a regular basis (Casamassimo et al., 2004), and they also do not have neccessary skills to to discuss family members' concerns (Friedlander et al., 2006; Green & Flanagan, 2008; Waldman, Perlman, & Wong, 2008).

The problem is therefore dual, so the caregivers of persons with ASD avoid taking them to the dentist, as well as dentists who are rarely willing to provide care for persons with ASD. The ultimate result is the finding of Marshall et al., (2010), where he reported that ASD may be considered an indicator for high caries risk, with oral hygiene being the most influential risk indicator associated with new caries in children with ASD.

Obstacles in getting proper dental care

By reviewing the literature, the main obstacles in getting proper dental care for persons with ASD and their caregivers were stated to be individual characteristics of people with ASD, sensory difficulties, unfamiliar environment and lack of dental staff training in treating people with ASD.

For many children with ASD, going to the dentist is a stressful event (Cohen & Donnellan, 1987; Howlin & Rutter, 1987;) and it is well known that for persons with ASD, medical and dental treatments are often extremely difficult to tolerate (Luscre & Center, 1996), therefore they can offer a limited collaboration to any procedures (Davit et al., 2011) and show avoidance behaviour during the oral assessment (DeMattei et al., 2007).

The results of a survey done on parents of children with ASD showed that 77 % of their children were frightened and uncooperative at their initial visit to the dentist (Swallow, 1969). Some authors claim that impaired social interaction, communication, cognitive dysfunction and other associated psychiatric symptoms may impede dental care (Barbaressi et al., 2006; Friedlander et al., 2006; Klein & Nowak, 1998; Pilebro & Backman, 2005), but others (Brickhouse at al., 2009; Lewis, 2009) claim that the child's behavior was found to be a major barrier. Therefore, Marshall et al., (2010) concluded that behaviour and life factors are asociated with increased dental risks.

These persons can be challenging to treat in a typical dental setting due to their often inappropriate behavioral patterns (Davila & Jensen, 1988) and Brickhouse et al., (2009) showed that children with ASD who exhibit problematic behaviour are less likely to have regular dental care. Moreover, cognitive dysfunction, the presence of aggressiveness, convulsions and other associated symptoms, reduce the possibility of being treated (Friedlander et al., 2006).

Going to the dentist is among the most challenging types of health care for persons with ASD, because of sensory inputs, such as loud or unusual sounds, strange smells, bright lights and having instruments in the mouth (Stein, Polido, & Cermak, 2013) and Baranek et al., (2006) found that 69% of people with ASD can have problems in processing sensory stimuli. Their lack of social and emotional capacity makes it difficult for dentists to explain dental procedures (Addelston, 1959; Swallow, 1969), as well as difficulties in comprehension, and general language impairment (Rapin & Tuchman, 2008). In addition, unfamiliar environment, as the dental environment and modifications in standard daily routines, often lead individuals with ASD to negative behaviours and may generate rage episodes (Howlin, 1998).

Therefore, these special characteristics often impede the children's ability to cooperate in dental settings (Brickhouse et al., 2009), but also some authors (Casamassimo et al., 2004; Dao et al., 2005; Nelson et al., 2011; Weil & Inglehart, 2010) claim that this is because of the reported inadequate training received by dentists to address such challenges, leading to many dental practitioners being unwilling to treat children with ASD.

Techniques of managing those obstacles

Different authors suggest several techniques that can be used to minimize stated obstacles. Those techniques include sensory adaptations, dental staff trainings, familiarizing with dental setting, Applied behavioral analisys, use of electronic screens, visual supports, auxiliary communication aids and in some cases general anestesia or physical restraint.

Delli, Reichart, Bornstein, & Livas (2013) claim that sensory stimulation should be minimized, because the dental examination light and the noise of a dental engine may be stressful for people with ASD who have visual and auditory hypersensitivity (Boddaert, Chabane, & Belin, 2004; Rogers, Hepburn, & Wehner, 2003). Also, visits to the dental clinic should be short and wait time minimized (Loo, Graham, & Hughes, 2009; Raposa, 2009), because Lai et al., (2012) reported that 13.8% of patients with ASD experienced difficulties while waiting for dental treatment. The presence of few other patients in the reception area can help to lessen fear and stress. The procedure itself must be well-organized and kept short. Lavish praise at the end help motivate the patient and establish the desired behavior (Burkart, 1984).

Before the actual appointment, some patients should undergo a conditioning process, including several rehearsals in a mock environment to familiarize them with the upcoming event (Kopel, 1977; Luscre & Center, 1996), also they should make their firts visit to the dentist around the age of one (Aličić, 2016). Hernandez and Ikkanda (2011) suggest that it is important for dentists to organize home-centered preparation before the actual appointment, where a person with ASD would get familiarized with dental instruments and taught the required skills for the dental examination, as well as developing custom-made photo books to assist the person with ASD to get acquainted with the dental operatory room.

Delli et al., (2013) recommends that dentists must have a deep understanding of ASD and the flexibility to modify their approach to meet the needs of the patient. Also, working with the same dentist and staff and having the parent accompany the person with ASD are also helpful practices (Marshall, Sheller, Mancl, & Williams, 2008), because generally, patients with ASD are more capable of tolerating procedures that are expected and predictable (Kuhaneck & Chisholm, 2012).

Applied Behaviour Analysis is the branch of psychology that through the analysis of the relationship of behaviour and the environment intends to modify behaviours to achieve desired effects (Hernandez & Ikkanda, 2011). Behavioural strategies have been used to teach children with ASD to be compliant with medical and dental procedures (Ghuman, Cataldo, Beck, & Slifer, 2004; Shabani & Fisher, 2006), as well as increases tolerance to them (Delli, Reichart, Bornstein, & Livas, 2013; Hernandez & Ikkanada, 2011).

In order to treat the patient, some dentists are providing dental treatment under general anaesthesia (Escribano-Hernandez at al., 2007; Loo, Graham, & Hughes, 2009), but many of the drugs have systemic side effects (Friedlander, Yagiela, Paterno, & Mahler, 2003; Ganzberg, 2003; Haas, 1999; Hersh, 1999; McEvoy, 2005; Psysicians desk reference, 2005; Wynn, Meiller, & Crossley, 2003). It is also noted that caregivers of persons with ASD have greater acceptance of general anesthesia for their child's dental treatment (Borges, Martins, & Almeida, 2007). Several authors (Lowe & Iedrychowski, 1987; McDonald & Avery, 1994) also suggest physical restraint for patients with ASD.

Some authors claim that other methods that can be used in dental settings are the use of electronic screen (Luscre & Center, 1996), because the preference for electronic often motivates children with ASD (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001; Charlop-Christy, Freeman, 2000; LeBlanc et al., 2003). Also, mobile devices can help people with ASD in their daily life activities (Santarosa & Conforto, 2015), as well as motivate compliance with an oral hygiene routine (Underwood, Birdsall, & Kay, 2015).

In 1999 a study was performed to evaluate the use of visual supports to introduce dentistry to children with ASD (Backman & Pilebro, 1999). After 18 months, most of the parents found maintaining good oral hygiene easier than they had found it before the study, because it takes advantage of the ability of persons with ASD to make better contact to pictures instead of words (Backman & Pilebro, 1999). Auxiliary communication aids such as the Picture Exchange Communication System (PECS), can also be usefull and can be brought to the dental visit (Bondy & Frost, 1994; Isong et al., 2014; Raposa, 2009).

CONCLUSION

Caregivers of persons with ASD have difficulties in locating a practitioner willing to provide care, because they received little or no training in their predoctoral dental education in threating these patients.

Some authors claim that impaired social interaction, communication, cognitive dysfunction and other associated psychiatric symptoms may impede dentalcare and also these patients can be challenging to treat in a typical dental setting due to their often inappropriate behavioral patterns.

Tecniques that can be used to improve dental care of patients with ASD are minimized sensory stimulation, short visits to the dental clinic and minimized wait time. Some advise several rehearsals in a mock environment to familiarize them with the upcoming event, as well as working with the same dentist and staff. Also, the presence of few other patients in the reception area can help to lessen fear and stress.

Behavioural strategies can also be used, electronic screen, visual supports, Picture Exchange Communication System. If all of the above does not give results, dental treatment can be provided under general anaesthesia, or physical restraint.

It is important for dental technicians to have propper training in providing dental care for these patients during their University studies, as well as to adjust used techniqes, because of individual differences of the patients with ASD.

In conclusion, we give recomendations for University school of dentistry to involve treating people with ASD in their practical aspects of studies, as well as educate prospecting students in using some of the stated techniques. Also, we believe it is necessary to conduct further research on obstacles people with ASD and their caregivers face while going to the dental office in our region.

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SENSORY PROCESSING OF PERSONS WITH AUTISM SPECTRUM DISORDER

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SUMMARY

Sensory processing is a complex, neurobiological process in which a person uses his/her senses, experiences information or stimuli from the environment, sends information to an appropriate centre for receiving and processing information, and responds to environmental stimuli. Sensory processing is the base of mental and social functioning, leading to the development of complex abilities at an older age. The authors emphasize the importance of the first seven years of life for the adequate development of sensory processing and therefore emphasize the importance of early intervention. Symptoms of incomplete sensory processing are manifested by atypical behavioural reactions in response to sensory stimulation. Atypical sensory processing stands out as a specific and universal symptom of people with autism spectrum disorder and most commonly manifests as hypo or hypersensitivity to various sensory information.

This paper aims to review and analyze the studies examining the specifics of sensory processing of persons with autism spectrum disorder. When reviewing the literature, all studies clearly show that individuals with autism spectrum disorder exhibit pronounced specificities in all domains of sensory processing. The most common problem is the processing of auditory information. Responses to sensory stimuli are context-dependent, in which a person may appear hypersensitive in a particular situation, while in another situation he may be hyposensitive to the same stimulus source. In addition to hypo and hypersensitivity, the problem of sensory integration and detection of stimulus sources is often manifested in these individuals. More recent studies also report the relatively frequent occurrence of distortion, synesthesia, and sensory-specific satiety.

Following the above findings, in order to plan adequate defectological treatment, it is necessary to take into account all the specifics of sensory processing of persons with autism spectrum disorder.

Key words: autism spectrum disorder, sensory processing, hypo/hypersensitivity

INTRODUCTION

More recent research in the field of child development confirms the importance of the first years of life for proper functioning and later development, emphasizing the fact that learning and development of brain functions are interdependent processes and as such play a very important role in the development of certain abilities and skills as a reflection of the first acquired childhood experiences (Fox & Rutter, 2010, according to Cvijetić, 2016). Therefore, increasing importance is given to early intervention to promote child development through individualized and specialized treatment and prevent stagnation of intellectual development. The effectiveness of these programs has been proven by many studies, with some of the key components of the success of early intervention programs highlighting early onset and longer duration (Cvijetić, 2016). To initiate an intervention on time, it is necessary to detect the earliest deviations in development and areas of disagreement. Several developmental screening tests can help us in this respect.

Most children enjoy a healthy and active childhood, independently engaging in daily activities according to their age, abilities and skills, necessary to them. These skills are expected to be mastered over a specific period, without or with minimal support from the environment. This also applies to the perception and processing of sensory stimuli. Sensory integration is a neurobiological process that organizes sensations from our body and environment and enables the efficient use of the body in the environment (Ayres, 1973). More broadly, sensory integration rests on preserved sensory processing, which implies the ability to perceive information or stimuli, then send that information to specific cortical fields where the information is received and processed to prepare an adequate response to registered stimuli (Gligorović, 2013). We receive all this information through the visual, auditory, tactile, olfactory, gnostic and vestibular systems known as our senses. Usually, we think of the senses as separate channels of information; however, they just need their integration to get a reliable picture of the world around us and our roles in it (Biel, 2009). In the first seven years of life, sensory processing and integration play an essential role in a child's later development since mental and social skills rest on these basic processes. For several months after birth, the child is mainly focused on the senses and movement and organizes the behaviour accordingly. He adopts, develops and modifies his first learned skills following those senses. The exploration of space, the creation of relationships with people around them, and the placement of themselves in spatiotemporal relationships also have their strongholds in sensorimotor processing. From all these skills, at a later age, complex integrative actions such as practical activities, speech, play, and even more complex ones, such as academic ability to read, write, compute, harmonious behaviour, and good socio-emotional relationships emerge (Maćešić-Petrović, 2014).

If our brains do not adequately discriminate, filter, organize, and integrate sensory information, resulting in inadequate directing of effective behaviour, then we are talking about sensory integration dysfunctions that can affect a person's daily functioning (Maćešić-Petrović, 2014). It is important to emphasize that we are talking about a disorder of sensory processing only when all the sensory receptors and neural pathways transfering information from the periphery to the centres in the brain are intact (Ayres, 2002). Children who have a sensory deprivation life in the early stages of development have little contact with people and things in the environment, do not adequately develop their sensory, motor and intellectual functions. However, although children are not exposed to situations of external sensory deprivation, they may have disorders of sensory processing and integration. Sensory stimulation may be present in the child's mid-range environment, but in some children, this information does not stimulate or reach all parts of the brain that should and need to be stimulated. Such internal sensory deprivation prevents cerebral development of functions that depend on complete sensory processing (Maćešić-Petrović, 2014). Symptoms of incomplete sensory processing are manifested by atypical behavioural reactions in response to sensory stimulation (Suarez, 2012).

Behavioural responses that are more pronounced than expected are called hypersensitivity (Grandin, 1992 according to Balasco, Provenzano, & Bozzi, 2020). A hypersensitive child may react hypersensitively to bright lights, such as a camera flash, but may also be disturbed by ordinary daylight, covering his eyes with his hands or wearing sunglasses, which may seem inappropriate. Such a child often avoids eye contact and shows the problem of maintaining attention due to visual distractors (Matsushima & Kato, 2013, according to Đurić-Zdravković, Japundža-Milisavljević, & Gagić, 2016). Also, children may be hypersensitive to auditory stimuli that are typical of everyday functioning such as home device sounds, traffic, or loud speaking. As a result, a violent emotional reaction may occur when children cover their ears and avoid the noise source. In the area of tactility, it can be avoided to wear a certain type of fabric whereby the child has a feeling of scratching or tightening, then avoiding hugs and vigorous rubbing of the affected part of the body. Refusing to wash the hair or cut the nails is also common. A hypersensitive child may also exhibit an aversion to certain odours and flavours, which may result in an over-selectivity of foods, confining themselves to dishes of typical texture and taste. Children with vestibular hypersensitivity have difficulty changing their walking or crawling directions on uneven or unstable surfaces. They feel disoriented after turning, jumping or running and often express fear and anxiety when their feet are not on the ground (Melillo, 2016, according to Marković, 2017). The problem can also occur at the level of the proprioceptive system; hypersensitivity is usually manifested by poor movement organization with the child impossibility to align body parts in a particular direction. The problem can also arise in the proprioceptive system, where hypersensitivity is usually manifested by poor movement organization due to misunderstanding of the relationships between those parts of one's body. As a result, children have a problem in manipulating objects, dressing independently and maintaining a certain body position (Ayres, 2008, according to Maćešić-Petrović, 2014).

In contrast, there are situations where children need a stronger sensory stimulus to register, process, and respond to it at all. Such children are said to be hyposensitive, that is, they lack the expected responses to typical stimuli (Baranek, Foster, & Berkson, 1997, according to Balasco, Provenzano, & Bozzi, 2020). These individuals show particular interest in illuminating objects and can thus gaze at the sun without having to close their eyes (Ayres, 2008, according to Maćešić-Petrović, 2014). They are fascinated by reflections and brightly coloured objects. When they enter an unfamiliar room, they walk around touching everything before settling down. They often sit for hours moving their fingers or objects in front of their eyes. They can search for sound sources, lean their ear on electrical equipment and noisy toys, or enjoy the crowds. They often make sounds themselves to stimulate hearing by banging on doors, tapping things, tearing up paper or producing rhythmic sounds (Ayres, 2008, according to Maćešić-Petrović, 2014). The authors of one study report that in some children, non-observation of olfactive stimuli occurs, while in other children, a pronounced problem can be observed in the form of hypersensitivity to the composition or structure of the meal and therefore some foods are rejected (Yasuda et al., 2016, according to Đurić-Zdravković et al., 2016). To stimulate the sense of smell and taste, children tend to intensively smell inedible objects, bring them to the lips or even to lick them. They like to mix flavours, such as sweet and sour (Goldstein & Morewitz, 2011). Such children need intense stimuli to get their attention. It may seem sometimes that such children do not feel pain or a change in temperature. In these cases you could expect them to be prone to self-harm, they may bite their hand or bang their heads against a wall. Pressure, tight clothes, tight hugs and rough and tumble games are something they prefer. They seek all kinds of movements and can turn or swing for a long time without dizziness or nausea (Melillo, 2016, according to Marković, 2017). People find them clumsy because they run into objects and other people and they often stumble and tend to fall.

Both types of reactions can occur in any domain of sensory processing or multiple domains simultaneously. One review study indicates that concurrent hypersensitivity for visual and auditory stimuli occurs in the range of 47.3% to 69% of individuals (Stefanelli, Zanchetta, & Furtado, 2020).

Sensory processing dysfunction is particularly prevalent in individuals with autism spectrum disorder (Glumbić, 2006). Sensory processing disorder is a common feature of individuals with autism spectrum disorder and can be considered as one of the criteria for diagnosis (Robertson & Baron-Cohen, 2017).

According to the DSM-5 classification (American Psychiatric Association, 2013), autism spectrum disorders (hereinafter referred to as ASD) belong to the group of neurodevelopmental disorders in addition to communication disorders, specific learning disorders, motor disorders, intellectual disabilities and ADHD.

ASD is characterized by a deficiency in social communication and social interactions that occur in different contexts that cannot be linked to general developmental delays, as well as limited, repetitive behaviours, interests, or activities. Symptoms must exist in early childhood, but they need not be fully manifested until social demands exceed capacity constraints or can be masked by learned strategies in later life. All of these symptoms together limit and impair daily functioning (American Psychiatric Association, 2013).

The aim of the paper

This paper aims to review and analyze the available literature reviewing the characteristics of sensory processing in children with ASD.

METHOD

An overview of the relevant literature was made through a review of the electronic databases available through the Consortium of Libraries of Serbia for Unified Acquisition (KOBSON) as well as Google Scholar Advanced Search. Searches were made through the following search engines: ScienceDirect, Ebscohost, SpringerLink and WileyInterScience. The following keywords were used in the search: autism, sensory profile, sensory processing, auditory processing, hyper and hyposensitivity, synesthesia.

Review of research

Sensory processing difficulties in children with ASD

Various data on the incidence of sensory processing difficulties in children with ASD can be found in the literature. According to Baranek et al., (2006), this percentage is 69%, while other authors state that as many as 95% of children with ASD aged three to six years have some kind of sensory processing disorder (Tomchek & Dunn, 2007, according to Đorđević, Glumbić, & Langher, 2019). Two more studies show that more than 90% of children with ASD exhibit some form of sensory dysfunction (Marco, Hinkley, Hill, & Nagarajan, 2011; Kilroy, Aziz-Zadeh, & Cermak, 2019).

Some authors report other prevalence results. They point out that difficulties in processing various sensory information are present in children with ASD in the range of 40 to 71%. The aforementioned difficulties in children manifest in the form of ignoring auditory stimuli or, on the contrary, overreacting, intensely observing the movements of their own hands, focusing attention on rotating objects or having many details, smelling edible and inedible objects, the unprovoked dropping of things out of hand and exaggerated delight when a person finds a new place (Ornitz, 1979; Bujas-Petković & Frey-Škrinjar, 2010, according to Mamić & Fulgosi-Masnjak, 2012).

The authors of one review study state that in many studies, atypical sensory processing stands out as a specific and universal symptom of people with ASD (Bogdashina, 2013). Today, atypical sensory processing is one of the diagnostic criteria of the American Psychiatric Association (2013). A description of unusual reactions to sensory stimuli has been noted in Kanner's earliest reports of people with ASD. He described that children with ASD were often afraid of loud sounds and the effect of moving objects (Kanner, 1943). These children can act very stubbornly as if they intentionally did not want to focus their attention on stimuli. While one day there is no response to certain stimuli, the next day may show an overreaction to that same stimulus. This indicates an inconsistency in the behaviour of persons with ASD and can be explained by the specific functioning of the brain of these individuals (Gourley et al., 2013; Miller et al., 2007, according to Đurić-Zdravković, Japundža-Milisavljević, & Gagić, 2016).

Asperger concluded that the response to sensory stimuli depends on the context, whereby a person may appear hypersensitive to noise in a particular situation, while in another situation they may be hyposensitive to the same noise level (Frith, 1991). Other authors have confirmed that the type of reactivity to the sensory stimulus differs significantly in the same person. They observed that a person may be hypersensitive to light and texture but hyposensitive to pain and the recall of their name (Elwin, Ek, Kjellin, & Schröder, 2013). These findings are supported by research results using different sensory reactivity assessment instruments. Thus, some results show that hyposensitivity to one type of stimulus is observed in 78% of subjects with ASD and that hypersensitivity to another type of stimulus can be observed in 44% of the same sample. 33% of individuals with ASD have been identified as hypersensitive to tactile types of information, but in contrast, only 4.4% of those individuals are hypersensitive to visual stimuli (Crane, Goddard, & Pring, 2009; Tavassoli et al., 2015, according to Taylor, Holt, Tavassoli, Ashwin, & Baron-Cohen, 2020).

In addition to hypo and hypersensitivity, the problem of sensory integration and detection of stimulus sources is often manifested in these individuals. More recent studies also cite the relatively frequent occurrence of distortion, synesthesia, and sensory satiety in people with ASD (Harrison & Hare, 2004, according to Đorđević, Glumbić, & Langher, 2019). Synesthesia is a condition in which a person unusually experiences the senses, for example, words can evoke tastes, sequences such as months and numbers can be visualized as spatial landscapes, and graphemes can evoke colours (Ward et al., 2017). In the general population, the prevalence of synesthesia is 2-4% (Simner, 2006, according to Leeuwen, Petersen, Burghoorn, Dingemanse, & Lier, 2019), while in people with ASD it is significantly more common and is around 20% (Neufeld et al., 2013, according to Leeuwen et al., 2019). The extremely high co-occurrence of synesthesia and autism suggests that the two conditions are related, but the exact nature of that relationship is unknown (Leeuwen et al., 2019).

In children with ASD, difficulties are most commonly detected in the domain of the auditory system (about 40% of cases), followed by the tactile and visual systems (19% of cases), and only 5% of the sample included children have difficulties in the olfactory system (Klintwall et al., 2011, according to Đorđević et al., 2019). In contrast to this research, the results of which coexist with many prominent studies, the authors Sakarneh, Sabayleh, and Alramamneh find slightly different results. Their study found that children with ASD most commonly exhibited difficulties in the domain of tactile perception, then olfactory, visual, and most rarely in the domain of auditory perception (Sakarneh, Sabayleh & Alramamneh, 2019).

In one retrospective study, involving over 200 individuals with ASD, the authors found that 100% of participants had problems processing auditory information (Greenspan & Weider 1997, according to Tomcheck & Dunn, 2007). Reviewing previous research, the same authors concluded that differences in auditory processing are one of the most commonly reported sensory processing problems in children with ASD (Bettison, 1994; Dahlgren & Gillberg, 1989; Gillberg & Coleman, 1996; Rimland & Edelson, 1995; Vicker, 1993, according to Tomcheck & Dunn, 2007). The screening was performed to cover a large sample of children with ASD. The authors found that of 94% of children who exhibited atypical responses to sensory stimuli, 39% showed insufficient sensitivity, 19% excessive sensitivity, and 36% of children combined sensitivity to stimuli (Greenspan & Wieder, 1998, according to Mamić, Fulgosi-Masnjak, & Pintarić-Mlinar, 2010).

Sensitivity to auditory stimuli in childhood is one of the strong discriminators between children with ASD and children without ASD (Dahlgren & Gillberg, 1989, according to Tomcheck & Dunn, 2007). Children with ASD usually do not pay attention to everyday stimuli, such as ringing or other noise, and often do not hear when spoken to. They may respond by panic to the sound of a vacuum cleaner, a motorcycle or other strong, intense sounds (Lang et al., 2012, according to Đurić-Zdravković, Japundža-Milisavljević, & Gagić, 2016).

Earlier studies aimed at determining whether the clinical manifestations of auditory hypersensitivity match the audiological findings of children with ASD have shown that as many as 76.1% of children surveyed have a neat audiological finding. A similar study examined the same issues and found that 55% of children with ASD, compared to only 6% of typical development children, exhibited the aforementioned problems. This fact has led the authors to conclude that behavioural manifestations of hypersensitivity to auditory stimuli are not related to auditory tract dysfunction, but rather that the problem arises at the level of the cortex (Gomes, Rotta, Pedroso, Sleifer, & Danesi, 2014; Demopoulos & Lewine, 2016). Also, studies comparing the EEG and MEG findings of children with ASD and children of the typical population have shown significant differences in response latencies in the auditory, somatosensory and visual cortex areas (Bruneau et al., 2003; Edgar et al., 2013; Marco et al., 2011; Miyazaki et al., 2007; Oram Cardy et al., 2008; Roberts et al., 2010; Vandenbroucke et al., 2008; Wilson et al., 2007, according to Cardon, 2018).

Many authors have noted the presence of tactile hypersensitivity in individuals with ASD (Blakemore et al., 2006; Cascio et al., 2008; Grandin, 1996; Marco, Hinklei, Hill, & Nagarajan, 2011; Tommerdahl, Tannan, Cascio, Baranek, & Vhitsel, 2007). Despite the increasing exploration of altered sensory processing in these individuals, the underlying mechanisms of the emergence of differences in responses to tactile stimuli have largely remained unknown (Tavassoli, Bellesheim, Tommerdahl, Holden, Kolevzon, & Buxbaum, 2015). Using the Short Sensory Profile, Rogers et al., found that there was a direct or indirect relationship between tactile information processing and adaptive behaviour (Rogers et al., 2003). The authors, who investigated hypo and hypersensitive responding in children with ASD, in addition to parental reports, made direct observation of the tactile activities of children. It was found that hyposensitivity responses to tactile stimuli have been unequivocally associated with the more pronounced social and communicative difficulties experienced by these children, whereas hypersensitive responses are positively correlated with nonverbal communication difficulties and repetitive behavioural patterns present (Foss-Feig et al., 2012). Based on the reports of parents who reported dysfunction of their children's tactile processing, a group of authors correlated tactile sensitivity with various components of attention (Wodka et al., 2016). In addition to hyperactivity, Hatch-Rasmussen cited the need for self-isolation, general irritability and distractibility as possible consequences of dysfunction of the tactile system (Hatch-Rasmussen, 2007, according to Christopher, 2019). Similarly, some authors point out those children who exhibit a higher level of tactile hypersensitivity will manifest behavioural problems, recurrent verbalizations, visual stereotypes, and difficulty maintaining and flexibly shifting attention (Baranek, Foster & Berkson, 1997; Cesaroni & Garber, 1991; Grandin 1995, according to Tomcheck & Dunn, 2007). A possible explanation for hyposensitivity to tactile stimuli is the mechanism of inhibitory control. They explain that tactile sensations reach the certain cortex structures by the thalamocortical route, stimulating cells that are responsible for inhibitory control of adjacent cells, thereby suppressing responses to tactile stimuli and thereby increasing the pain threshold in these individuals (Carpenter, 2003; Markram & Markram, 2010; Markram, Rinaldi, & Markram, 2007; Puts, Edden, Vodka, Mostofski, & Tommerdahl, 2013; Puts et al., 2013; Zhang, Francisco, Holden, Dennis, & Tommerdahl, 2011, according to Tavassoli, et al., 2015).

There was also a strong positive association between tactile abnormalities and severe delay in global self-regulation such as appetite, sleep, and attention, suggesting that atypical touch responses may have effects on a wide range of individual functioning (Silva & Schalock, 2013, according to Christopher, 2019).

Research findings in the field of visual perception are different, depending on whether the identification or discrimination of a visual stimulus is examined (Kushki et al., 2011). People with ASD generally score worse on tests that require the perception of the human face than other stimuli (Behrmann, Thomas, & Humphreys, 2006).Given that a human character requires global rather than local visual processing, such results are not surprising given that people with ASD tend to focus on a single detail and are often unable to view the larger picture (Happé, & Frith, 2006; Robertson & Baron-Cohen, 2017). Visual perception in people with ASD is associated with a deficit in social skills (Dakin & Frith, 2005). The authors linked the time of fixation to a specific part of the face of the interviewee and associated with success in social competence (Klin, Jones, Schultz, Volkmar, & Cohen, 2002). Participants observed short movie inserts showing dialogues from a specified distance from the computer. Data logging began after each participant reported an adequate level of comfort and unobstructed view of the screen. Eye-tracking was made possible by a system that unobtrusively fitted on the participant's cap. Participants with ASD focused more on the mouth than on other parts of the face. Earlier studies found that people with ASD tend to focus on the lower parts of the face when observing the interviewee (Langdell, 1978). It was determined that respondents with ASD those with a longer fixation on the mouth were most likely to have better social skills than subjects who had a longer fixation on subjects. On the other hand, increased fixation on the mouth does not necessarily imply that the person's focus of attention is on speech. As the authors explain, the reason for this opinion is the fact that people with ASD often have a problem of prosody and context comprehension relative to word understanding. If participants are asked to perform a segmental speech perception task, the respondent focuses on the part around the lips (Lansing, McConkie, 1999, according to Klin, Jones, Schultz, Volkmar, & Cohen, 2002). However, if participants are asked to perform a prosodic speech perception task, then the respondent focuses on the upper face area. In this study, we can observe that respondents focused on the literal aspects of speech and less on the facial expressions of speakers (Klin et al., 2002). The ability to evaluate facial expressions and obtain socially relevant information by observing the interviewee's facial expression is one of the conditions for reciprocal social interaction and interpersonal communication (Lansing & McConkie, 1999).

Some studies have suggested that people with ASD have certain facial recognition abnormalities. In an experiment evaluating face recognition, it was found that children with ASD had lower face recognition compared to their peers with typical development (hereinafter referred to as TD). The same study also evaluated discrimination against persons and objects, where TD peers were better at discriminating against unknown persons. There was no difference in distinguishing the objects. Such results suggest that impaired facial recognition is not a result of attention deficit and discrimination, but rather that it is associated with ASD characteristics (Boucher & Lewis, 1992). In tasks where the goal is to single out a particular stimulus, in addition to many distractors, people with ASD are more successful than TD persons (Robertson & Baron-Cohen, 2017). There is a wealth of literature available to suggest that people with ASD have abnormalities in face perception. Tantam and co-workers compared children with ASD and TD children in finding unusual facial and object expressions among the photographs offered. Children with ASD were predominantly unsuccessful in extracting unusual facial expressions, naming emotions, but were successful in tasks requiring them to single out a particular subject or to display a face depicted in reverse. Such findings imply the possibility of a different way of processing visual information in individuals with ASD (Tantam, Monaghan, Nicholson, & Stirling, 1989).

In children with ASD, selectivity in food selection is noticeable at an early age. Parents of children with ASD describe their children as picky, and prone to rejecting foods of a particular texture, taste, or appearance (Christopher, 2019). This can be a problem in nutritional independence in children with ASD. In addition to independence, constipation and poor oral-motor development can occur due to over-picking (Shea, 2015). Excessive selectivity in eating is influenced by parents' suggestions, choice, sensory perception, visual and gustatory (Blissett & Fogel, 2013). Too much selectivity in choosing and rejecting new foods can grow into neophobia (Kumazaki et al., 2018). Neophobia is one of the major obstacles to introducing a diverse diet. It is noticeable that neophobia is more appropriate in persons who have worse discrimination of smell and taste (Luisier et al., 2015).

Benetto, Kushner, and Hyman (2007) compared the taste and odour sensation of ASD and TD persons. It has been observed that olfactory identification is worse in individuals with ASD than in TD, and gustative in the case of sweet and salty stimulations and less accurate for bitter and acidic flavours. The authors concluded that poorer results in people with ASD imply that there is a problem with the sensory processing of the senses of taste and smell. Considering that taste and odour discrimination tasks represent sensory tasks and identification is a verbal task type, these findings may be related to the fact that individuals with ASD often have problems with verbal labelling and semantic memory (Hedner et al., 2010; Oberg et al., 2002, according to Galle, 2013). The problem of identifying odours and flavours, but not detecting them, suggests a deficit in the social sphere of people with ASD (Suzuki, Critchley, Rowe, Howlin, & Murphy, 2003). Disorders in the processing of olfactive stimuli are one of the predictors of poorer social functioning of people with ASD (Bennetto, Kuschner, & Hyman, 2007).

Sensory processing and age

One study was conducted comparing the quality of sensory processing of younger and older examinees with ASD. The authors examined accuracy when identifying offered odours, and younger children were found to be much more accurate in identifying stimuli than older respondents (Brewer, Brereton, & Tonge, 2008, according to Balasco, Provenzano, & Bozzi, 2020). In a subsequent study, 3 years later, the same subjects expressed more difficulty in identifying olfactory stimuli (May et al., 2011, according to Balasco et al., 2020). However, it has not yet been determined how and when altered olfactory processing occurs in children with ASD (Galle, Courchesne, Mottron, & Frasnelli, 2013). Other studies examining the quality of sensory processing in children of the typical population aged 3 to 10 years using the first version of the Sensory Profile (Dunn, 1994) as a measuring instrument, found no statistically significant differences in the quality of sensory processing concerning age and gender of respondents (Dunn & Westman, 1997). Baranek et al., (2006) conducted an extensive study of 258 children of both sexes with ASD and found no statistically significant differences in the quality of sensory processing between boys and girls (Baranek et al., 2006).

CONCLUSION

The literature review showed different data on the frequency of sensory processing difficulties in children with ASD. It can be found that 40% to over 90% of children with ASD exhibit some form of sensory dysfunction. The most common difficulties are hypo and hypersensitivity to auditory stimuli, then tactile, visual and least to olfactory ones. In addition to hypo and hypersensitivity, the problem of sensory integration and detection of stimulus sources is often manifested in these individuals. More recent studies also report the relatively frequent occurrence of distortion, synesthesia, and sensory satiety. Some authors point out that the inconsistency in the behaviour of persons with ASD can be explained by the specific functioning of the brain structures of these persons. Sensitivity to auditory stimuli in childhood is one of the powerful discriminators between children with ASD and children in the typical population. Many authors have noted the presence of tactile hypersensitivity in people with ASD; however, the underlying mechanisms for the emergence of differences in responses to tactile stimuli have largely remained unknown. Hyposensitive responses to tactile stimuli are linked by the authors to the more pronounced social and communication difficulties experienced by these children. Visual perception difficulties are associated with a deficit in social skills. It has not been determined whether this is due to fewer social interactions or due to difficulties in processing visual information. In children with ASD, at an early age, selectivity in food selection is noticeable, which may be an obstacle to the independence of these children and may lead to inadequate oral motor development.

Given the importance of complete sensory processing to the harmonious development of persons in all life fields, it is clear why these specifics of sensory processing of persons with ASD must be taken into account.

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DISABILITY IN A FAMILY AS A FACTOR FOR DEVELOPING ATTITUDE TOWARDS DEAF AND HARD OF HEARING STUDENTS IN INCLUSIVE EDUCATION[a]

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SUMMARY

Inclusion is the process of wider involvement of children with disability into mainstream education system and further on into various social aspects. Inclusion promoters claim that the acceptance of children with disability by their peers in mainstream schools is a corner stone of inclusion. Promoters believe that positive attitude of typically developing students is a crucial factor of successful implementation of inclusion process. Hearing impairment is the most frequent congenital sensory handicap. Hearing impairment affects speech and cognitive development and therefor presents significant health and social burden in the considerable part of population.

The goal of this study was to assess if the presence of a disabled person in a family could affect the attitude of older students (6th, 7th and 8th grade) towards deaf and hard of hearing students in mainstream school. The instrument in this study was the adapted questionnaire Attitudes toward Deafness a four-point 25-item rating scale (Cowen et al., 1967).

The study was conducted in five mainstream primary schools. The sample contained 255 typically developing students of both genders, attending 6th, 7th or 8th grade. They came for various social strata.

The results have shown that the students have mostly positive attitude regarding deaf and hard of hearing schoolmates. Students coming from families with disabled person usually have developed more sympathetic attitude.

Key words: inclusive education, attitude of mainstream students, deaf and hard of hearing

INTRODUCTION

The Ministry of Education, Science and Technological Development in bylaws from 2009 has defined inclusive education as accessible, quality and justified for every child. The concept of inclusive education relies mainly on Education for all (EFA) concept and improvement in schools. Instead of being preoccupied with a certain group, inclusive education is focused on overcoming obstacles in learning and participating. UNESCO conference in Salamanca in 1994 have outlined that the inclusion process is directly related to overall improvement of education system.

Inclusion is a process of finding solutions and responding to various needs of all students in order to avoid exclusion of any student from the education process. It

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requires changes and adjustment of contents, approach, structures and strategies, according to the common vision, encompassing all the children of certain age group and belief that the mainstream education should respond to every child need. Inclusion refers to wider involvement of children with disability in mainstream education and afterwards in every segment of social and professional life (Jablan & Kovačević, 2008).

Attitudes are usually defined as an acquired and permanent system of positive or negative evaluation, influencing the tendency to act in favor or against certain object, situation, institution, term or person (Dulčić & Bakota, 2008; Fajgelj, 2007). It is important to keep in mind that attitudes are acquired or learned, not inherited. Attitudes are usually long lasting, although not final and could be changed over time (Krstić, 1988). The attitude is formed based on direct or indirect experience in contact with the subject over socialization process. It is very important in the context of inclusive education of deaf and hard of hearing children as well as other children with disability.

Impact of deafness or hearing impairment on education potentials

According to the World Health Organization (WHO) data 1-3 out of 1000 newborn babies have significant bilateral permanent sensorineural hearing loss (WHO, 2010). Additional 3 out of 1000 children acquire hearing loss during early childhood (Cunningham & Cox, 2003). There is no comprehensive data on overall number of children with permanent hearing loss in Serbia, but the results of numerous studies have confirmed the frequency (1-3 per 1000) congruent with WHO data (Babac, Petrović-Lazić, Tatović, Stojanović-Kamberović, & Ivanković, 2010; Mikić et al., 2011; Nikolić, 2016; Ostojić, 1999; Ostojić & Mikić, 2010).

Negative impact of hearing loss on speech and cognition development makes the deafness and hearing impairment an important issue of public health affecting considerable population (Barišić, Sansović, Knežević, & Pavelić, 2004). Education process for the deaf and hard of hearing children should be adjusted to their specific functioning.

In terms of education, auditory information is usually more present than the visual ones. Development of speech and language as a basic communication tool is highly integrative process requiring harmonized functioning of several aspects: anatomical, physiological, auditory, mental, emotional and social (Ostojić, 2004). Communication competence of deaf and hard of hearing children is frequently defined by seriously deteriorated speech and language. Advanced verbal communication capacity provides harmony of emotional, educational and social development of the deaf and hard of hearing person.

Impact of inclusive education on deaf and hard of hearing students

The school setting can considerably contribute to the self-confidence and acceptance when the child is successful and accepted by teachers and peers. When the child is not adequately accepted by the peers in the class he will probably search for peers outside his class, adhering to the group of individuals with similar problem.

Despite the continuous attempts, deaf children are generally less successful in interaction with peers as compared to hearing kids. Even when they succeed, their interactions are shorter and less complex. Deaf children spend less time than the hearing ones interacting with peers in organized games or free activities (Guralnick et al., 1996).

However, the social interaction of the deaf students with typically developing schoolmates in inclusive settlement is not always positive, especially due to communication issues (Stinson, Kluwin, 2003). Deaf adolescents in mainstream schools have higher self-esteem and consider themselves more responsible, talented and successful than their deaf peers in the schools for the deaf. Self-perception of the deaf students in the mainstream schools is dominantly positive even if they are not fully accepted by typically developing peers (Stinson & Kluwin, 2003).

Review of the studies regarding deaf and hard of hearing students in mainstream education imply that interaction with typically developing peers could positively affect their self-esteem and socio-emotional self-confidence (Stinson & Kluwin, 2003; Hsin-Ling Hung, 2005; Radić-Šestić, Milanović Dobrota, Kaljača, & Dučić, 2012). The results of one study have shown high acceptance of the deaf students aged 10 to 20 years by their hearing peers, especially girls and younger students. Deaf girls were generally better accepted than the deaf boys, emphasizing the gender influence (Cambra, 2002).

The results of the study done by Radić-Šestić et al., (Radić-Šestić, Milanović Dobrota, Kaljača, & Dučić, 2012) also imply that the deaf adolescents from mainstream schools have better chance to be accepted by the hearing peers and to develop pro-social skills, than deaf and hard of hearing students from the schools for the deaf. Deaf subjects who socialize with their deaf and normally hearing peers equally, manifest higher self-esteem than their deaf peers confined to the deaf community. They are more satisfied with their looks, more self-confident , consider themselves appreciated by their parents, teachers and peers as well as more successful and less lonely than their deaf peers from the school for the deaf.

Mainstreaming helps the deaf and hard of hearing students identify with their hearing peers. Numerous studies on inclusive education have provided additional proofs that inclusion is not only education, but socialization as well. Children are learning a great deal from each other. Communication between disabled and typically developing children improves and enhance speech development, social skills and personality features. Behavior of typically developing children represents a positive role model, which is easily accepted and imitated by children with disability. Children with disability have positive influence on their peers as well. Compassion and understanding of their problems inspire the typically development students to develop altruism and curiosity about human body and its functioning (Cerić, 2006).

Successful inclusion could have overall positive impact on the deaf and hard of hearing students. Numerous subjective and objective factors could affect the inclusion success as has been discussed before. According to the advocates of the inclusive education, attitude of the typically developing students have been considered essential for successful implementation of inclusion (S. Stainback, W. Stainback, Strathe, & Dedrick, 1983).

Objective of the study

This is the part of the extensive study regarding different factors (gender, age, social environment, parents education, disabled person in a family, quality of communication) that could affect the attitude of older students towards deaf and hard of hearing students in inclusive school settings (reference). The authors will analyze the impact of a disabled person in a family on older students' attitude towards the deaf and hard of hearing children in inclusive education.

Having a family member with disability makes the family and wider social circle more sensitive to the specific disability related issues. It has been widely known and proved by numerous studies (Burke & Cigno, 1996; Burke & Montgomery, 2001; Glendenning, 1986; McCormack, 1978) that children with disability require more support from parents and entire family. About 80% of children with disability have typically developing siblings (Atkinson & Crawford, 1995), so that the topic of the distribution of parental care and support has been widely investigated. This study did not take the type of disability in the family into consideration. The topic was the attitude of the students who had family member with disability towards the deaf and hard of hearing students in the inclusive education system.

Theoretical foundation of this study is based on the fact that the Ministry of Education, Science and Technological Development in bylaws from 2009 has defined inclusive education as accessible, quality and justified for every child. The concept of inclusive education relies mainly on EFA (education for all) concept and improvement in schools. Instead of being preoccupied with a certain group, inclusive education is focused on overcoming obstacles in learning and participating. UNESCO conference in Salamanca in 1994 have outlined that inclusion process is directly bound with overall improvement of education system.

Inclusion is a process of finding solutions and responding to various needs of all students in order to avoid exclusion of any student from the education process. It requires changes and adjustment of contents, approach, structures and strategies, according to the common vision encompassing all the children of the certain age group and belief that the mainstream education should respond to every child need. Inclusion refers to wider involvement of children with disability in mainstream education and afterwards in every segment of social and professional life (Jablan & Kovačević, 2008).

The goal of the study

The basic goal of the study was to discover if the existence of a family member with disability could affect the attitude of students in 6th, 7th and 8th grade of primary school towards their deaf and hard of hearing mates in inclusive school setting.

Based on this goal, the following hypothesis has been defined. The presence of family member with disability could positively impact students' attitude towards the deaf and hard of hearing students in inclusive education setting.

METHOD

The study has been conducted in five mainstream schools: one metropolitan, two suburban and to country schools in Serbia.

The data were summoned in accordance with school calendar following previous consultation with school authorities and employees.

The methodology of survey has been explained to participants beforehand. They were assured that their participation is anonymous and voluntary, as well as that they will be allowed to drop out of the process anytime. The researcher had explained the protocol and the task to the students. They were participating individually in a survey in their classroom. The time appointed for a survey has been 30 minutes.

Sample

The sample included students of 6th, 7th and 8th grade of mainstream primary schools. All of them had average intelligence and was typically developed. The study has encompassed 255 students, 134 (52.5%) males and 121 (47.5%) females. Seventy-eight students were in the 6th grade, ninety-five in the 7th grade and eighty-two in the 8th grade. Majority of the students, 114 attended metropolitan school, 71 country school and 70 suburban school.

Table 1. *Distribution of respondents who have disabled person in family*

Disability in family	**Frequency (*f*)**	**Percentage %**
Yes	46	18.0
No	209	82.0
Summary	255	100.0

Instrument

Adapted questionnaire Attitudes toward Deafness Scale A four-point 25-item rating scale (Cowen, Rockway, & Bobrove, 1967) presenting a single dimensional scale for assessment of attitudes towards deaf and hard of hearing persons, has been used in this study. The Serbian translation of a scale consists of 25 items. Four-point Likert-type rating scale has been used, ranging from 1 - totally disagree to 4 - totally agree. Cronbach alpha coefficient was 0.83.

Statistical analysis

Following statistical methods have been applied for evaluation of statistical significance: t-test for independent samples, One-way ANOVA, Pearson bivariate correlation. Statistical package SSPS 20.0 has been used for data analysis.

RESULTS

Descriptive characteristics of results obtained by the adapted questionnaire Attitudes to Deafness Scale, are shown in Table 2. In descending order, so that the items with most positive and most negative answers could be easily seen.

Table 2. *Descriptive analysis of Attitudes toward Deafness a four-point rating scale (Cowen et al., 1967).*

Attitude	**Min**	**Max**	*M*	*SD*
The deaf have as many interests as the hearing have.	3	4	3.55	0.498
A person who is deaf is as apt to be born a leader as anyone else.	3	4	3.41	0.493
Deaf people seem to be overly polite and to lack spontaneity.	3	4	3.33	0.472
A deaf person is not afraid to express his feelings.	3	4	3.31	0.465
The deaf are prone to have many more fears about the world than the hearing.	3	4	3.24	0.430
Because of his need to be pitied, it is particularly important that the deaf person has someone very tolerant to whom he can talk.	1	4	2.77	1.10
It is difficult to understand the deaf because they keep so much to themselves.	1	4	2.67	0.870
The deaf are prone to have many more fears about the world than the hearing.	1	4	2.65	0.927
A deaf person is constantly worried about what might happen to him.	1	3	2.65	2.07
Deaf people are more easily upset than people who can hear.	1	4	2.49	0.879
The deaf are usually on their guard with people.	1	4	2.49	0.918
I feel that deafness is as hard to bear as complete paralysis.	1	4	2.43	0.923
Deaf people somehow seem sadder and more wrapped up in themselves than hearing people.	1	4	2.40	0.925

Attitude	**Min**	**Max**	*M*	*SD*
Most deaf people are dissatisfied with themselves.	1	4	2.37	0.926
Most deaf people feel that they are worthless.	1	4	2.36	0.854
A deaf person cannot afford to talk back to people.	1	4	2.23	1.010
It must be bitterly degrading for a deaf person to depend so much on others.	1	4	2.21	0.844
Deaf people also seem to have more than the usual number of other physical complaints.	1	4	2.19	0.807
Deaf people show personality characteristics which frequently make them seem odd.	1	4	2.04	0.804
You should not expect too much from a deaf person.	1	4	2.01	0.930
In general, deaf people are more neurotic than those who hear.	1	4	1.91	0.676
The deaf adult is not quite as mature or “grown up” as the hearing adult.	1	4	1.81	0.870
The deaf generally have a less mature personality than the hearing.	1	4	1.76	0.720
Overall, deaf children seem to be less intelligent than hearing children.	1	4	1.70	0.857
It is impossible to really get “close” to a deaf person.	1	4	1.68	0.791

The difference in attitudes between students with and without family member with disability tested by t-test for independent samples has been showed in Table 3.

Table 3. *Attitudes of students with and without family member with disability toward deaf and hard of hearing students*

Attitudes toward deaf and hard of hearing students	**Disability in family**	*N*	*M*	*SD*	*Std. Err. Diff.*
	Yes	46	62.46	7.78	1.16098
	No	209	59.60	9.06	0.62887

Results of inferential statistics are shown in Table 4. Results are showing the significance of difference between attitudes of students with vs without family member with disability, toward hearing impaired peers.

Table 4. *Attitudes toward deaf and hard of hearing students*

		Levene's test for equality of variances		**t-test**				
		F	*Sig.*	*t*	*df*	*Sig. (2-tailes)*	*Mean diff.*	*Std. Err. diff.*
Attitudes toward deaf and hard of hearing students	Assumption of equal variances	2.027	0.156	-1.965	251	0.051	-2.86154	1.45640
	Assumption of unequal variances			-2.167	72.285	0.034	-2.86154	1.32036

The results for statistical significance obtained in this study represent borderline significance ($p = 0.05$). Since the sample was not homogenous, we assumed the variance inequality since insignificant Leven test of variance equality. The Table 4 has shown $p = 0.03$ which correspond the level of significance $p < 0.05$.

Overall analysis has shown that students with disabled person in family generally have more positive attitude towards their deaf and hard of hearing schoolmates.

Hypothesis regarding positive influence of having a person with disability in a family on student attitude towards the deaf and hard of hearing peers has been confirmed.

DISCUSSION

The objective of this study has been to evaluate if the presence of a disabled person in a family of the students of 6th, 7th and 8th grades could affect the attitude towards the deaf and hard of hearing students in inclusive education.

Model based learning is well known technique in psychology, especially significant for children and adolescents. The way that significant adults are conveying messages and attitudes to the young ones in the family is essential. Their influence is crucial for successful social integration of individuals with disability. According to numerous authors, there are three levels of influence of significant others that could affect self-concept definition and social integration of disabled individuals. The first level consists of peers, family members and close friends. The second level consists of professionals, such as doctors, social workers, teachers, advisors. The third level is the community reaction to the public engagement of individuals with disability, which conveys important message to them (Altman, 1981).

Regarding that aspect, the authors have concluded that studying the attitude of hearing students towards deaf and hard of hearing school mates should be considered as priority, since it is directly related to their successful inclusion at very early age.

According to the analysis of descriptive results regarding attitude scale, the best congruence has been achieved regarding the following statement: "Deaf persons have various interests as much as the hearing ones". Other statements with similar results (M > 3) have been as follows: "Deaf person is capable of leadership as any other", "Deaf persons seem very kind", "Deaf person is not afraid to show his feelings", "It does not seem that deaf persons worry more about usual life issues than hearing ones". All that implies that participants in this study mostly or completely have agreed that the deaf persons have certain interests, desires and needs as anybody, such as sharing feelings, leadership or dealing with everyday life issues.

On the other hand, the biggest discrepancy has been observed for the statement: "It is impossible to approach the deaf person". Similar disagreement is obvious (M < 2) at following items: "Deaf persons are generally more neurotic than hearing ones", "Deaf persons are not as mature as hearing ones", "Basically, deaf kid seem to be less intelligent than hearing ones". That implies that majority of the participants in this study think that deaf and hard of hearing persons are as intelligent and mature as the hearing ones.

Analysis of the answers has shown that positive statements are grouped between marks 3 and 4, which implies high degree of approval. On the contrary, most negative statements obtained disapproval (marks 1 and 2), which means that the attitude of older students has mainly positive attitude regarding the deaf and hard of hearing individuals.

That is true for one half of the statements from the scale. Response to the other half is variable tending to be either positive or negative. The greatest variation has been observed for following statement: "Deaf persons are usually cautious in contact with hearing ones" (M = 2.49), "Deaf persons get annoyed more easily than the hearing ones" (M = 2.49), "I consider the deafness as hard to stand as complete paralysis" (M = 2.43). Those attitudes could be considered neutral.

Numerous studies about attitudes towards deaf and hard of hearing persons have shown congruent results about majority of neutral or mostly positive attitudes regarding this population (Cambra, 2002; Dimoski, 2011; Emerton & Rothman, 1977; Furnham & Lane, 1984; Nikolaraizi & De Reybekiel, 2001; Radoman, 1995).

However, not all studies about the attitudes towards the deaf have shown consistent results. Uzelac (1989) has found a lot of neutral statements in her study about attitude towards the deaf and hard of hearing students. Cowen et al., (Cowen, Rockway, & Bobrove, 1967) in their report have found dominantly negative attitude towards the deaf and hard of hearing persons, relating that to other socio-psychological statements and values, negative perception of minority groups and pro-authoritarian policies.

This study has investigated the influence of a person with disability in the family. Hypothesis about the influence of the disability in a family on attitudes towards the deaf and hard of hearing has been confirmed. Participants in the study who had a disabled person in the family have shown more positive attitude towards the deaf and hard of hearing students (Table 3). This result confirms the fact that previous contact with disabled person within family could affect future attitude considerably. Quality and frequency of such contacts within family is extremely important.

CONCLUSION

Results obtained in this study have shown that the participants from older school group who had a disabled person in a family have developed more positive attitude towards the deaf and hard of hearing students in inclusive educational setting.

Attitude of students towards the deaf and hard of hearing is dominantly positive. Majority of students has considered that the deaf and hard of hearing persons have mostly interests, desires and needs as anybody else, such as the need to share feelings, leadership or dealing with everyday issues. The positive attitude regarding intelligence or maturity of the deaf and hard of hearing persons was common finding in this study.

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THE ADVANTAGES OF BILINGUALISM OF DEAF AND HARD OF HEARING CHILDREN[a]

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SUMMARY

The population of deaf and hard of hearing children is very heterogeneous and, because of this, the existence of different approaches is needed in education in order to meet their communication and educational needs successfully. Hearing and speech impairment leads to certain specificities and difficulties in the development of these children, which requires adequate methods and approaches in the process of rehabilitation and education, and great support and encouragement from the family, the preschool institution, the school and the environment.

Results of numerous studies indicate that the best approach in education, for most of the deaf children, is bilingualism, or bilingual approach. Bilingualism is knowledge and regular use of sign and spoken language in deaf and hard of hearing children. Bilingualism of the hearing is different from the bilingualism of the deaf. Bilingual normal hearing children, as well as deaf children, learn two languages. The difference is that they learn a second language through auditory means, in the same modality as a first language. Deaf children learn two languages in two modalities, which is considerably more complex.

The basic objective of the paper is to, by reviewing the available literature, point to what the advantages of bilingualism in deaf and hard of hearing children are. Bilingualism is an advantage to typically developing children; likewise, it is an advantage to children with permanent hearing loss, beyond the points raised earlier. Exposure to sign language does not hinder the development of spoken language or any other cognitive development; to the contrary, many cognitive, social, and educational benefits follow from bilingualism.

Key words: bilingualism, advantages, deaf and hard of hearing children

INTRODUCTION

Bilingualism of a deaf child means the knowledge and regular use of sign language, which is used by the community of the deaf, and the spoken language, which is used by the majority who can hear. Knowing and using sign and spoken language, deaf and hard of hearing children will realize their full potential in intellectual, speech and social development (Kovačević, 2019).

Bimodal bilingualism is defined as using two languages in two modes, both visual and auditory, signed language and spoken language (Mitchiner, 2015). This is type of bilingualism that employs two different input-output channels, one involving spoken language and the other involving sign language (Atulebi & Clahsen, 2016).

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The concept of dual language use of spoken and sign language by deaf children and adults is referred to in various ways in the literature, with bimodal bilingual being just one of the terms used internationally. Other terms include: sign bilingual, bilingual deaf education, bilingual-bicultural and co-enrolment.

Bilingualism is the knowledge and regular use of two or more languages. Bilingualism of the "sign language - spoken language" type is the only way for the deaf child to meet its needs, ie. to, from an early age, communicate with its parents, develop its cognitive ability, get to know the world, communicate fully with the environment and acculturate into the world of those who hear and the world of the deaf (Grosjean, 2001).

Bilingual research with hearing speakers has consistently found that proficiency in two or more languages results in better mental flexibility and cognitive control, which persists through late adulthood and may delay the onset of dementia by as much as four years (Bialystok, Craik, & Freedman, 2007). Bilingualism in both hearing and deaf people leads to more creative thinking, particularly in problem solving, and to more creative verbal processes (Kushalnagar et al., 2010).

Bilingual development of deaf and hard of hearing children

Bilingualism brings many cognitive, communicative and cultural advantages. Bilingualism has positive effects on metalinguistic awareness, executive functions and cognitive abilities (Barac & Bialystok, 2012; Goldstein & Bunta, 2012).

Bimodal bilingualism of deaf and hard of hearing children is defined as the use of two languages (sign and spoken language) in two modalities (visual and auditory). The bilingualism of the hearing persons is different from the bilingualism of the deaf. Bilingual hearing children learn two languages, just like the deaf children do. The difference is that the second language (L2) is learned in auditory manner, in the same modality as the first language (L1) (Knight & Swanwick, 2002). Deaf children learn two languages, in two modalities, which is much more complex. When hearing children are learning a second language (L2), it is completely accessible to them and it is not limited by any physical factors. Deaf children cannot hear their second language (L2) completely. Deaf children of deaf parents naturally adopt sign language at home and learn L2 formally at preschool institutions, although they often adopt both languages simultaneously (Kovačević & Đoković, 2019).

Over the years, educators have questioned whether exposing young deaf children to bimodal bilingual input would impair their ability or motivation to achieve age-appropriate language acquisition and literacy levels (Mayer & Leigh, 2010) and to learn spoken English (Hyde & Punch, 2011). When evaluating the effectiveness of bilingual programs for deaf children, there has been a dearth of empirical evidence of improved language and academic outcomes that are equivalent to those of their hearing peers.

Early bilingualism in hearing impaired children (knowledge of sign language and spoken / written language) is invaluable for their development (Kovačević, Đoković, Isaković, & Dimić, 2020). Appropriate and effective early communication, regardless of within which linguistic modality (sign or spoken) it takes place, together with the acceptance of the child and its impairment, is the basis of successful cognitive development and the development of the child's personality, which is the basis of communication and of building the language skills (Ann, 2001; Meir, 2002; Perniss, Pfau, & Steinbach, 2007).

Bilingualism refers to the phenomenon of knowledge and regular use of two languages. Many studies speak of the positive impact of bilingualism or the adoption of a non-native language on the development of various forms of meta-language ability, and that leads to the conclusion that the adoption of language is not only a process of acquiring communication skills, but also a formative factor that influences the overall psychological development of the child (Titone,1994). Research in the field of bilingualism and cognitive functioning has shown that early bilingualism and constant, everyday use of two or more languages lead to earlier maturation of certain cognitive processes in children (Bialystok, 2001).

Sign language is a language that deaf children spontaneously adopt and learn, like normal hearing children adopt the spoken language of their environment. The adoption of sign language eliminates the problems of limited receiving of messages and limited communication. When communicating with a deaf child, speech that is followed by a gesture-sign should be used until the child learns spoken words and understands their meanings (Kovačević, 2012).

Sign and spoken languages include various perceptual and productive systems. While spoken languages include mechanisms of auditory processing and speech production, sign languages are perceived visually, and their articulation involves the systematic use of parts of the body and space (Kovačević, 2013; Plaza-Pust, 2005).

When teaching deaf children sign language and spoken language, the most important thing is to provide an environment and situations that are stimulating enough to motivate a child to communicate using both languages. One of the basic assumptions of the bilingual development of deaf children is that it is necessary to provide them with opportunities to communicate interactively with both their peers and adults, both with hearing and deaf people, both in sign language and in spoken language. It should be borne in mind that the language has its own spoken, written and sign expression, and these expressions should be used both together and individually (Ardito, Caselli, Vecchieti, & Volterra, 2008).

Bilingual development of children with CI

Earlier studies on bimodal bilingualism mostly focused on studying the bimodal bilingual development of hearing children of deaf adults (CODAs) who acquired signed and spoken language from birth (Berent, 2004; Emmorey, Borinstein, Thompson, & Gollan, 2008; Emmorey & McCullough, 2009). Recent studies on cochlear-implanted children's language outcomes began to include those who use sign language and spoken English at their early ages (Davidson, Lillo-Martin, & Chen Pichler, 2013).

Hassanzadeh (2012) compared the spoken language outcomes of seven deaf children with cochlear implants who have deaf parents with a similar group of deaf children with cochlear implants who have hearing parents. The study results showed that the children with Deaf parents outperformed children with hearing parents in their speech perception, speech production, and language development, leading Hassanzadeh to conclude that early access to sign language appeared to enhance their abilities to develop spoken language after cochlear implantation.

Similar evidence was found in Rinaldi and Caselli's (2014) recent longitudinal study on language development in a bimodal bilingual child with cochlear implants. The child was raised in a bilingual environment with hearing parents and siblings using Italian Sign Language and spoken Italian and also attended a day care that used bimodal bilingual approaches. Multiple linguistic measures were used to assess the child's lexical development in language comprehension and production periodically during the 3 years of the study, from 2.6 to 5.1 years of age. The results indicated his language skills were at the same level as those of his monolingual hearing peers. The researchers suggested that signed language supported the acquisition of the second language. This study also suggested that a bimodal bilingual environment is achievable with hearing families by providing their children with cochlear implants access to both languages as well as both the hearing and deaf communities (Mitchiner, 2015).

Nowadays, there are around 80% of cochlear implanted children in the developed world, which enables them to develop the approach to sound at an early age and helps them develop speech. However, due to the changes in brain plasticity in early childhood, children who did not acquire language at their earliest age cannot be fluent in any language. If the exposure to the natural language is skipped, their later development of cognitive activities may be insufficiently developed (Humphries et al., 2012).

Alterative approach to language acquisition is the use of sign language, such as American Sign Language (ASL). Sign language is subject to the same limitations of the speech and language development. There are no reliable predictors of success with cochlear implants. The family of a deaf child is frequently advised against exposing the child to sign language. These absolutely ideological positions put pressure on the parents and may actually jeopardise the developmental needs of deaf children.

There is evidence to be found in the literature that exposure to sign language enhances, rather than reduces, spoken language development (Preisler, Tvingstedt, & Ahlström, 2005; Yoshinaga-Itano, 2006). Authors reported on children whose early development of sign language appeared to facilitate their development of spoken language after cochlear implantation and suggested that any modality plays a major role in the development of spoken-language development.

Hyde and Punch (2011) investigated the modes of communication used by deaf children who had received cochlear implants and reported that access to both spoken and sign language does not lessen the proficiency of children's spoken language development. Authors claimed that exposure to a bimodal bilingual input in fact optimized deaf children's cognition and language at critical stages in their development. Furthermore, there is considerable research evidence that children who are bimodal bilinguals use both languages as part of a language continuum rather than their communication mode remaining static (Watson, Hardie, Archbold, & Wheeler, 2008). This finding is further supported by reports of interviews with deaf young people with cochlear implants, who stated that they use whichever language is best suited to their needs at the time (Wheeler, Archbold, Hardie, & Watson, 2009). From all accounts, therefore, deaf children are able to make use of both language modalities to an extent determined by the level of their sensory impairment, the quality and frequency of input and their motivation to communicate (Mirus & Napoli, 2018).

All children need to acquire language. Some deaf children acquire a spoken language via an assistive aid, such as a cochlear implant, but there is little predictability as to which children will succeed (Yoshinaga-Itano, Baca, & Sedey, 2010). In contrast, a sign language is accessible for all deaf children and many now recommend that all deaf children learn a sign language, with the idea that, if they happen to also acquire a spoken language, they will have the added benefit of being bimodal-bilingual, but in no case, will they be linguistically deprived (Hall, 2017). Deaf and hard of hearing children who sign have better academic achievements, including reading.

Advantages of sign language acquisition

While children easily acquire any accessible natural human languages (spoken or signed) to which they are regularly exposed (Sandler & Lillo-Martin 2006), the acquisition of a first language must take place before the critical period, which may be as early as five years old. If not, children may well have difficulties becoming fluent in any language — they will be linguistically deprived. Research in developmental psychology has found a correlation between reduced language abilities and social difficulties. The development of language is critical to the organization of memory, mastery of cognitive skills such as numeracy and literacy, and many other aspects of cognitive development. High proficiency in a language permits a child to engage in social interactions with family and peers, and cognitive development is enhanced by environmental stimulation. Successful social interaction calls for a higher order of cognitive processing, called executive functioning, which has been significantly positively associated with language ability (Figueras, Edwards, & Langdon, 2008). It is, therefore, critical that a deaf child becomes a fluent signer. Further, in the absence of a signing environment, deaf children tend to develop a gestural system of communication with those around them, anyway (Goldin-Meadow, 2005). It is far better in terms of both cognitive development and communicative range to give them bona fide language. This recommendation is further supported by a neuroimaging study that reports greater activation in language-specialized regions of the brain in signers when they view sign language, as opposed to non-linguistic gestures. Finally, language is language, regardless of the modality. Integration and differentiation processes within a linguistic system and across different linguistic systems aid development of language in general, thus, learning sign language can help a child master a spoken language (Kushalnagar et al., 2010).

For children who are deaf or hard of hearing and cannot fully access linguistic meaning through audition, the use of ASL has been documented to promote linguistic, communication, cognitive, academic, and literacy development as well as social emotional growth and identity formation. Evidence also indicates that there is a risk of language delay if an accessible language is not used as early as possible, even for children who have some level of access to spoken language through a hearing aid or cochlear implant (Mayberry, Lock, & Kazmi, 2002). The brain has the capacity to acquire both a visual and a spoken language without detriment to the development of either, and there is no documented evidence demonstrating that ASL inhibits the development of spoken English (Marschark & Hauser, 2012).

Studies of sign language acquisition in children show that sign language development is comparable to spoken language development. This knowledge is mainly based on research in the

USA and the UK with deaf children of deaf parents, demonstrating that early fluency in sign language leads to equivalent word and sentence level milestones and pragmatic skills (Swanwick, 2016).

Deaf children who are exposed, from the earliest age, only to sign language go through the same basic levels of language acquisition as normal hearing children who learn to speak in their environment (Kovačević & Isaković, 2019). Anderson (2006), points out to the data obtained by Anderson & Reilly (2002) in their study. The obtained data points out to remarkable similarity of the first signs and words in ASL - American Sign Language and English spoken vocabulary. These authors point out that it is evident that from the age of 18 - 23 months, the productive vocabularies (of signs or words) of deaf and normal hearing children, when compared, are more or less the same.

The list of the first words, or gestures-signs that children adopt, points out to very strong similarities between the early lexical contents in deaf and normal hearing children. The first signs-gestures of deaf children are semantically similar to the first words that are produced by normal hearing children. In the phase of single-element statements, deaf children also use isolated signs or words - nouns or verbs (for example: mother, father, baby, eat, drink, milk, ball, dog ...), just like normal hearing children do (Mayberry & Squires, 2006).

The family of a deaf child is well-advised to learn a sign language, because language communication is an integral part of family health and happiness, as well as of the deaf person's health and happiness (Kushalnagar et al., 2011; Mirus & Napoli, 2018).

Bilingual communication in a family of deaf and hard of hearing children

Its family is extremely important for developing and shaping the personality of the child. Its family provides the child with the experience of belonging to the community and the experience of the value of the family as an institution. A child's natural environment is the family environment, which has an irreplaceable role in the shaping of its personality. Within the family, the child gains emotional experiences, learns the rules of interpersonal relationships and of behaving in the society (Kovačević & Đoković, 2018).

Due to hearing impairments and a changed way of communicating with the environment, deaf and hard of hearing children develop under more unfavorable conditions than normal hearing children. A large number of deaf and hard of hearing children have specific problems in the fields of communication and interaction. The child's inability to communicate with family and other children isolates it, with the passage of time, and leads to deeper difficulties in the social and emotional plan and overall development.

Communication is one of the fundamental elements of living, because its use is for the communication of people in a certain community. Communication or language provide the society with a medium and means for socializing its members.

About 90% of deaf children were born in families with two hearing parents, 7% have one deaf parent, and only 3% have two deaf parents (Marschark, 1993). Approximately 5-10% of deaf children adopt sign language from their deaf parents (Mitchell & Karchmer, 2004). Most deaf children grow in a completely normal hearing world in early childhood. Also, most of the hearing parents of deaf children have no knowledge, or have poor knowledge of sign language, which has significant implications for the development of the deaf child.

Around 96 percent of children with hearing loss are born to parents with intact hearing, who may initially know little about deafness or sign language (Moores, 2001). Therefore, such parents will need information and support in making decisions about the medical, linguistic, and educational management of their child. Some of these decisions are time-sensitive and irreversible and come at a moment of emotional turmoil and vulnerability. Clinical research indicates that a deaf child's poor communication skills can be made worse by increased level of parental depression (Kushalnagar et al., 2007). Given this, the importance of reliable and up-to-date support for parents' decisions is critical to the overall well-being of their child. In raising and educating a child, parents are often offered an exclusive choice between an oral environment (including assistive technology, speech reading, and voicing) and a signing environment (Kushalnagar et al., 2010).

For the deaf children of hearing parents, their first language will be spoken language. If hearing parents choose sign language, it will not be adopted in the same way as is the case with the deaf children of deaf parents. Hearing adults use spoken language simultaneously with sign language, and in addition to that, their skills of emission and reception of sign language are often incomplete and are under strong influence of the structure of spoken language.

Deaf children (usually of hearing parents) who are beginning to learn sign language after the critical period for language acquisition (until the end of their fifth year of age) have, on average, worse language skills in sign language. The development of sign language fluency for this group of deaf children is problematic as they experience a general delay in sign language development and difficulties in catching up. This has been evidenced through scores on standardised sign language assessments (Herman & Roy 2006) as well as general language comprehension (Rodríguez, 2007) and early pragmatic and narrative competence (Becker 2009; Surian, Tedoldi, & Siegal 2010).

This delay is explained in part by the limited access to everyday conversation and routine interactions, such as story telling or parental commentary around a shared activity. Hearing parents reportedly find it difficult to learn sign language as adults, as a second language (L2) (Napier, Leigh, & Nann 2007; Von Pein & Altarriba 2011). Even though many of these families do develop their own *homesign*, these communication strategies do not fulfil the experience of early access to a fluent language from birth (Janjua, Woll, & Kyle, 2002; Morford & Hänel- Faulhaber, 2011; Swanwick, 2016).

The deaf child requires to be included in the process of rehabilitation of hearing and speech early, which is a prerequisite for the child's progress in language development and speech development, as well as in psychosocial and emotional development. It acquires its experience in various ways, but its most influential and most responsible teacher is its parent. Parents should be educated about hearing loss, its consequences and communication, upbringing and education of the deaf child (Kovačević, Isaković, & Dimić, 2016).

Bilingual educational approach

Many deaf children are raised strictly orally, but the auditory information they receive through hearing aids and cochlear implants may not provide language access. "A bilingual approach protects academic success since exposure to an accessible language is the key to developing native-like proficiency in any language, and a solid first language foundation is also critical for the successful acquisition of a second language" (Mounty, Pucci, & Harmon, 2014, p. 334). Regardless of their speech skills, deaf children who feel confident in signing do better academically in reading (Scott & Hoffmeister, 2017) and writing (Basha Ludago, 2014), whether their parents are hearing or deaf (Hassanzadeh, 2012).

A bilingual educational approach gives deaf children the opportunity to learn sign language and spoken/written languages and grants them access to the curriculum in whichever language is most accessible to them in an environment that values deafness, sign language and deaf culture (Swanwick, 2010). This approach has been labelled *sign bilingual* in some contexts and *bilingual bicultural* in others (Marschark & Lee 2014). The term *cross-modal bilingualism* is also used to indicate the use of two different languages and two different modalities (Menéndez, 2010).

For the development of language, deaf children should be exposed to good language models in a signed language as soon as deafness is detected. There is no advantage to delaying exposure to sign language, and research on the development of language has found that early exposure reduces the risks of linguistic deprivation, which is frequently associated with cognitive impairment and psychosocial isolation (Swanwick, 2016).

The acquisition of sign language has educational benefits. Many studies report that deaf children who sign, regardless of other factors (such as whether their parents are deaf or hearing and whether or not they have assistive hearing devices and/or oral training), achieve better in school than those who don't sign. A recent study concludes that skill in ASL, above other possible factors, correlates strongly with achievement in reading, suggesting that the linguistic basis of reading can be bimodal as well as bilingual (Chamberlain & Mayberry, 2008).

The deaf children of deaf parents achieve significantly better results than the deaf children of hearing parents. They control the language of the hearing environment better, have better school achievements, are emotionally more mature, have greater self-esteem, are more independent, have less behavioral disorders, even achieve better results on nonverbal tests of intelligence than the deaf children of hearing parents. They have shown that sign language is useful, and not harmful, for the overall development of the child (Marschark, Schick, & Spencer, 2006; Swanwick, 2016).

Bilingual education programs for deaf children are springing up all over the world. Bilingual/bicultural educational programs differ in pedagogical approach; all stress the importance of sign language as a language for the exchange of academic ideas, but some support voicing of spoken language as well, while others pair sign with the written language of the country (Kovačević, 2013).

The identification and recognition of sign languages in the world has resulted in changes in the policy of educating deaf children. Thirty years ago, bilingual schools for deaf children, in which sign language had the status of the first language, and the language of the hearing environment is learnt by deaf children as a second language, appeared in the world. In bilingual schools, deaf children learn both languages (sign and speech), adopt meta-language knowledge about them, develop expression and creation in both languages, get to know both cultures, and the teachers know both forms of expression. Evaluation of such forms of the education of deaf children has shown excellent results (Kovačević, Isaković, & Arsić, 2019).

The bilingual-bicultural approach to educating deaf children has been very well designed and developed in the Scandinavian countries (Sweden and Denmark), and increasingly so in the other countries of Europe, America, and Australia, as well. The model of bilingual education is called the "Bi-Bi model" (bilingual-bicultural), i.e. a bilingual-bicultural model that implies the restructuring of the entire system of the education of the deaf, from early childhood, preschool institutions, schools, to faculties. This model implies the inclusion of children in the life of the deaf community, socializing with peers and adults, as well as the education of hearing parents of the deaf children in communicating in sign language. It begins with the application of early intervention programs in working with hearing parents and little deaf babies. Through early intervention programs, hearing parents are enabled to: learn the national sign language; have advisory assistance with regards to the treatment of the child; be involved in the life of the deaf community; socialize with adult deaf people and deaf peers of their deaf children.

Deaf adults play an important role as models for speech and social identification of deaf children. Education and employment of deaf teachers in kindergartens and schools for deaf children is necessary, as well. Young deaf persons are provided with university education with the support of an interpreter. In school work, new contents are first covered in sign language, and then in spoken language, whereby the integrity of the input of language information is ensured through the use of written word. It is important that a child understands that these are two separate languages, as a premise of transfer from the first to the second language. In communication and learning, the manually coded language of the hearing majority (speech followed by the sign) is not used, the original sign language of the deaf community is used instead. Deaf students learn about the specificities of the culture of the majority community in which they live, but also about the different specifities of their cultural community - history, artistic creation, customs and values of the deaf community (Bradarić-Jončić & Kolarić, 2012).

1. Over the last few decades, in developed countries and in our country, there has been a steady increase in the number of deaf and hard of hearing children in regular education conditions. Bilingual approach in the education of deaf children can be successfully implemented in regular education and training conditions, in regular preschool institutions and schools, through bilingual programs for the education of deaf children and the presence of sign

interpreters - educational translators (Kovačević, 2019). In the new models of integration of deaf children, which are more and more present in the world, efforts are being made to align the aims and requirements of the traditional models of educational integration and the requirements contained in the models of bilingual-bicultural education of the deaf. Such integration, as a rule, implies the so- called co-teaching (team teaching, cooperative teaching) model, where, along with the regular teacher, a sign language interpreter and a teacher for deaf children participate (Kreimeyer, Crooke, Drye, Egbert, & Klein, 2000).

2. Teachers, and teachers in kindergartens should be provided additional education on the specificities of hearing disorders and the education of deaf and hard of hearing children. The support that influences the educational achievements of deaf and hard of hearing children in regular educational institutions includes the degree and type of support by teachers and special education teachers, customized communication, appropriate amplification, precise interpreting into sign language and appropriate visual and acoustic surroundings (Luckner & Muir, 2001; Schick, Williams, & Kupermintz, 2006). For communicating with deaf and hard of hearing children, it is important to have equal access to information (Isaković & Kovačević, 2015). For the deaf children that use sign language, interpretation into sign language should be provided; for those who use written language, it is necessary to provide subtitles in the national spoken language; for children who prefer lip reading in a combination with listening it is necessary to have support from a speech interpreter. For the hard of hearing children, it is necessary to provide optimal conditions for receiving acoustic information by using, for example, FM (frequency modulation) systems in classrooms, or inductive loop at public events.

CONCLUSION

The rationale for raising and educating deaf children bilingually draws on principles of bilingual and multilingual communication from around the world. Bilingualism in signed and spoken languages, as it is used by a significant population of deaf and hearing adults around the world, is a practical goal in deaf education. It develops naturally in many families with deaf parents and hearing children without known deleterious effects. Just as millions of hearing children grow up speaking two or more languages that are structurally quite different (such as Chinese and English) without worry that the children will be at a disadvantage in learning one language if they speak the other, there has been no evidence that hearing children who grow up with sign and spoken language are at any educational disadvantage. Raising a child bilingually, with a bilingual/bicultural education is effective and ethical. Dual proficiency in sign language and spoken language affords a deaf child with the added benefit of adapting to both signing and non-signing peer groups with greater ease, which can result in better overall socio-emotional and behavioral development.

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THE COMPARISON OF RESILIENCY LEVELS OF DEAF AND HARD OF HEARING ADOLESCENTS AND THEIR TYPICALLY DEVELOPING PEERS[a]

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SUMMARY

Deaf and hard of hearing children lag in communication skills, which may consequently result in a lower level of resilience. Determining resiliency levels in deaf and hard of hearing adolescents in comparison to the typical development of their peers is for this reason set as the objective of this research. The sample included 60 sixth, seventh and eighth grade primary school pupils, aged 12 to 14. The subjects were divided into two groups: Group A (30 deaf and hard of hearing subjects) and Group B (30 subjects with typical development). The Resiliency Scale for Children & Adolescents (RSCA) was used in this research. The results showed that deaf and hard of hearing students perceive their resiliency the same as their typical developing peers. Under conditions where more and more deaf and hard of hearing children are educated with peers of the typical population, the social integration of these children becomes a key concern. Programmes intended to promote the development of resiliency, which are drafted in accordance with the individual characteristics of deaf and hard of hearing children may contribute to their successful inclusion in mainstream education.

Key words: resiliency, deaf and hard of hearing, adolescents

INTRODUCTION

One of the most widely accepted and cited definitions of resilience is that it is a positive adaptation despite adverse circumstances or trauma (Luthar, 2003). Differences in defining resistance come from different understandings of this concept, as a trait, process, or outcome. Regardless of different understandings, there are two essential moments for resilience in all definitions - positive adaptation and negative circumstances (Masten et al., 2009, according to Johnson, Cawthon, Fink, Wendel, & Schoffstall, 2018). Differences in understanding resilience were illustrated by the following example cited by a British group of authors (Young, Green, & Rogers, 2008). Namely, with an insight into the literature related to resilience, two members of the team showed two distinct gestures for the same term in the British sign language. One showed a gesture of "protection" with the movement of the hand facing the body and the other one showed a gesture of "resistance" moving the clenched fist away from the body.

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Several protective factors have been identified in the literature that are related to the characteristics of an individual or environment, and Masten and Reed (2002) include IQ, regulation of emotions, inner family agreement and characteristics, school effectiveness and safe environment as protective factors. Werner and Smith (Werner & Smith, 1982, according to Liebenberg, Joubert, & Foucault, 2017) included personality characteristics, cognitive capacity, self-efficacy, and optimism in individual protective factors. In order to develop these traits, the same authors state that a high level of early childhood care, supportive relationships with relatives, teachers, and mentors are required. Summarizing the literature, Polk (1997) identified four qualities that describe resiliency: dispositional (self-confidence, basic security, good physical health, and sense of autonomy); relational (intimate relations, relations with institutions of the social system); situational (taking adequate action concerning the situation, giving an adequate response, ability to solve problems); philosophical (beliefs that promote resilience - positive thinking).

Earlier work in the field of the resilience of deaf and hard of hearing (DHH) (children, adolescents, adults) has considered hearing impairment as a risk factor for developing resilience. More recent literature (Young et al., 2008) states that the medical model of disability has imposed the understanding that deafness is a risk factor, while according to the social model of disability, deafness is not seen as a risk factor but rather that external conditions, such as barriers in communication contribute to risk increase. A study by a group of authors (Radovanović, Radić Šestić, Kovačević, & Dimoski, 2020) confirmed that the degree of hearing impairment is not a factor that significantly affects the resiliency of DHH adolescents. Deaf children face communication problems very early, starting with parents, who are hearing in 90-95% of cases and have no experience with hearing impairment (Mitchell & Karchmer, 2004). While growing up, this barrier extends to more people through peers, teachers, other significant people in the environment, and later to life partners (Johnson et al., 2018; Young et al., 2008). Research findings indicate that DHH adolescents with better communication skills are more accepted by their peers in inclusive schools (Bat-Chava & Deingan, 2001; Scheetz, 2004).

The period of adolescence is a period of accelerated changes in physical, cognitive, emotional, and social development. The nature and extent of these changes will be more difficult to understand for DHH adolescents with poorly developed language and communication skills. During adolescence, many of the earlier developmental processes and outcomes can be reflected later in adulthood. Some authors see the problem of communicating with parents as an early-stage “developmental trauma” unique to the deaf (Anderson, Wolf Craig, Hall, & Ziedonis, 2016). Supportive families, as well as a supportive wider environment, can assist deaf adolescents in this transition period. Parenting schools, early intervention programs aimed, among other things, at developing resiliency, allow many personal and environmental risk factors to reduce and positive outcomes to emerge (Hintermair, 2006; Pollard & Rendon, 1999, according to Radovanović et al., 2020). Although ecological systems theory (Brofenbrenner, 1986) suggests multiple ways for resilience support, it cannot provide a comprehensive understanding of the extent and nature of the risks that deaf adolescents face. In order to prevent potential negative outcomes, it is necessary to consider the risk factors for each individual, which originate from personal characteristics, family or environmental conditions (Luft, 2011).

Few studies have dealt with the concept of the resilience of DHH children and adolescents, and some authors primarily examining the relationship between resilience and academic success in different academic settings (Charlson, Bird, & Strong, 1999; Charlson, Stonf, & Gold, 1992). Findings of the research that compared the resilience of the deaf and their hearing peers indicate that emotional and social skills are internal factors that greatly influence academic and social achievement (Zimmerman, 2015).

Bearing in mind the importance of communication skills and the role in building social relations with peers during adolescence in the works above, as well as research findings showing that DHH pupils in regular schools feel lonely (Batten, Oakes, & Alexander, 2014; Charlson, Strong, & Gold, 1992; Van Gurp, 200, according to Radovanović et al., 2020), this study aimed to determine differences in the level of resiliency of DHH adolescents and their typically developing peers. In addition to differences, we were interested in the extent to which age, gender, academic achievement, parental educational attainment, and the way of communication of DHH pupils affect resilience.

METHOD

The sample consisted of 60 pupils of the sixth, seventh and eighth grades of elementary school, aged 12-14. The respondents were divided into two groups: group A (30 DHH pupils) and group B (30 typically developing pupils). The age structure of group A consisted of 9 twelve-year-old (30%), 11 thirteen-year-old (36.7%) and 10 fourteen-year-old (33.3%), while the gender structure consisted of 16 (53.3%) boys and 14 (46.7%) girls. The age structure of group B consisted of 8 twelve-year-old (26.7%), 11 thirteen-year-old (36.7%) and 11 fourteen-year-old (36.7%), and the gender structure was 13 (43.3%) boys and 17 (56.7%) girls. The sample was matched by age ($\chi^2 = 0.106$; $p = 0.948$) and gender ($\chi^2 = 0.601$; $p = 0.303$).

Resiliency Scales for Children & Adolescents (RSCA) (Prince-Embury, 2007) was used in this study. It consists of three subscales: Sense of Mastery Scale (MAS), which measures optimism, self-efficacy and flexibility, Sense of Relatedness Scale (REL), which measures trust, social support, social comfort and tolerance and Emotional Reactivity (REA), which measures sensitivity, recovery and impairment. The first subscale consists of 20, the second of 24, and the third of 20 statements, to which pupils respond by rounding one of the answers from 0 (never) to 4 (almost always). The Resilience Scale measures the personal resilience of children and adolescents between the ages of 9 and 18. With the increase of the total score, the degree of the resilience of the respondents on the first two subscales increased, while on the third scale, the higher score indicated increased emotional reactivity and vice versa. The internal consistency coefficients of the individual scales are satisfactory and are: $\alpha = 0.817$ for the MAS scale, $\alpha = 0.882$ for the REL scale, and $\alpha = 0.894$ for the REA scale.

The research was conducted in the spring of 2018 in one regular and three schools for DHH children on the territory of the Republic of Serbia. In the regular school, the questionnaire was administered in groups of fifteen children, and in schools for DHH individually.

Quantitative data are expressed in frequencies and percentages. Arithmetic means were used as a central tendency measure which express average scores on the scale and certain subscales. The significance of differences between arithmetic means was examined by t-test and analysis of variance.

RESULTS AND DISCUSSION

The results of Group A and Group B pupils obtained on the scale, as well as on the individual subscales, are shown in Table 1.

Table 1. *Results obtained on the Resiliency Scale with regard to a group of subjects*

	Group	M	SD	t	p
MAS	A	50.53	11.79	0.286	0.776
	B	51.30	8.75		
Optimism	A	16.70	4.85	0.761	0.449
	B	17.60	4.29		
Self-efficacy	A	32.77	7.28	0.553	0.582
	B	33.70	5.71		
Flexibility	A	8.00	2.57	0.272	0.286
	B	7.80	3.09		
REL	A	62.83	14.71	0.103	0.918
	B	62.47	12.67		
Trust	A	18.33	4.64	0.241	0.810
	B	18.60	3.90		
Social Support	A	22.57	5.95	0.368	0.714
	B	22.03	5.27		
Social Comfort	A	10.93	2.73	0.955	0.433
	B	10.20	3.20		
Tolerance	A	16.27	4.66	0.634	0.529
	B	17.03	4.71		
REA	A	32.60	13.14	0.564	0.123
	B	26.73	15.80		
Sensitivity	A	12.67	4.48	1.677	0.099
	B	10.60	5.05		
Recovery	A	6.47	3.86	1.875	0.066
	B	4.43	4.52		
Impairment	A	13.47	6.91	0.888	0.378
	B	11.70	8.43		

$p < 0.05$

Based on the results presented in Table 1, it can be concluded that DHH pupils achieved approximately the same scores as their hearing peers on the MAS and REL subscales, only the achievement on the REA subscale is lower than the achievement of hearing pupils, but the results aren't statistically significant.

Observing the results within the MAS scale for individual domains, it can be seen that DHH pupils achieved slightly lower scores in the *Optimism* domain. Since optimism and positive thinking are more permanent personality traits, it would be advisable to conduct more extensive research on this topic among DHH adolescents, given that some studies have shown that adult deaf people suffer from depression (Kvam, Loeb, & Tambs, 2006; Leigh & Anthony-Tolbert, 2001). Emotions play an important role in daily life: they determine the way in which the influence of social relationships is understood and expressed, the way people behave in difficult situations and how interpersonal conflicts are resolved. Research shows that problems in understanding emotions can be linked to the development of psychopathological symptoms or poor social functioning in life (Eisenberg, Spinrad, & Eggum, 2010). Lower scores of DHH pupils were also recorded in the area of *Self-efficacy*. In adolescence, when there is a decrease in learning motivation, attention should be paid to empowering and assisting adolescents in the positive development of self-efficacy, in order to develop motivation and perseverance in solving problems over time (Radić Šestić & Milanović Dobrota, 2012). According to the same authors, a decrease in motivation can lead to a decrease in academic and self-regulatory self-efficacy, which not only reflects on school success but also has consequences further in life.

The results of the REL scale for individual domains show that there are slightly lower scores of DHH pupils in the domain of *Social Comfort* and *Tolerance*. The greatest differences were obtained within the REA scale in the *Recovery* domain. The results of the REA scale, although not statistically significant, may indicate difficulties in the emotional regulation of DHH pupils, which opens the space for further research. More recent studies indicate that DHH children with different amplification tools exhibit internalized and externalized behavioral disorders (Theunissen et al., 2015). Strong emotional reactivity is associated with behavioral disorders and can lead to pathology (Prince-Embury, 2011). Emotional regulation is a significant factor in resistance incitement (Cicchetti, Ganiban, & Barnett, 1991, according to Prince-Embury, 2011). Language deficits in DHH children are associated with executive functions and may lead to poorer behavior regulation (Corina & Singleton, 2009).

Achievement on the Resiliency Scale with regard to age

There is an increase in resiliency with age, with research results showing that the largest increase is in the *Self-esteem* domain (Frost & McKelvie, 2004). In this study, no statistically significant differences were found concerning age, both at the level of the whole sample and in the subsample of DHH pupils, which can be related to the sample size. The results showed that scores on the MAS and REL scales increase with age, even on the REA scale in DHH pupils. The greatest difference was found in the domain of *Impairment* within the REA scale, where the average score of DHH fourteen-year-olds in this domain was 15.80, while the average score of the typical population was smaller, 11.73. A higher score on the REA scale is associated with a higher risk of behavioral problems (Prince-Embury, 2011), so the results would require further research as these are the sensitive years and the different mechanisms by which children attempt to cope with the various problems this period brings, all in order to take appropriate measures and procedures in time to improve resistance.

Table 2. *Scores on the MAS, REL and REA scales with regard to age of pupils*

	Age	N	M	SD	F	p
Group A						
MAS	12	9	43.56	7.09	2.163	0.135
	13	11	52.30	14.38		
	14	10	53.55	11.22		
REL	12	9	57.11	10.85	1.712	0.200
	13	11	59.30	18.23		
	14	10	65.00	13.836		
REA	12	9	29.22	14.12	0.702	0.504
	13	11	32.45	14.42		
	14	10	36.40	10.83		
Group B						
MAS	12	8	50.36	8.689	0.253	0.778
	13	11	51.91	7.440		
	14	11	53.25	9.770		
REL	12	8	60.36	14.236	0.488	0.619
	13	11	65.27	10.374		
	14	11	68.18	12.85		
REA	12	8	29.63	14.372	0.224	0.801
	13	11	26.18	16.552		
	14	11	24.64	17.019		

Achievement on the Resiliency Scale with regard to gender

Table 3. *Achievement on the Resiliency Scale with regard to gender*

	Gender	N	M	SD	t	p
Group A						
MAS	M	16	49.36	13.81	0.277	0.774
	Ž	14	50.81	10.30		
REL	M	16	59.43	16.90	0.272	0.399
	Ž	14	64.06	12.70		
REA	M	16	34.94	13.40	0.738	0.348
	Ž	14	30.36	12.79		
Group B						
MAS	M	13	51.29	9.39	0.589	0.773
	Ž	17	52.23	7.75		
REL	M	13	62.94	12.27	0.614	0.824
	Ž	17	64.00	13.50		
REA	M	13	29.18	16.38	0.921	0.301
	Ž	17	23.08	14.81		

The results presented in Table 3 confirm that there is no difference in the level of resiliency with regard to gender in both A and B groups, although the results of other studies have shown that girls, in some aspects of social skills-related resiliency, had a higher score than boys (Broderick & Korteland, 2002; Hampel & Petermann, 2005). In this study, the greatest differences were found in the *Flexibility* domain within the MAS scale, where the mean value for girls was 8.07 and for boys 7.74 and in the *Tolerance* domain within the REL scale, where girls achieved a score of 17.62 and boys 15.74. Research results show that girls at this age are more flexible in using different adjustment strategies (Selman, 1980). The results reported by Cicognani also indicate that girls use a wider range of activities when dealing with everyday stressors than boys (Cicognani, 2011, according to Radić Šestić, Kovačević, & Milanović Dobrota, 2014), and the author emphasizes the importance of self-efficacy and social support in coping with this.

Achievement on the Resiliency scale with regard to school success

Table 4. *Achievement on the Resiliency scale with regard to school success*

			Group A			
	school success	N	M	SD	t	p
MAS	very good	12	48.00	13.35	0.523	0.606
	excellent	15	50.42	9.86		
REL	very good	12	57.93	15.25	0.898	0.397
	excellent	15	62.83	13.12		
REA	very good	12	31.67	15.02	0.053	0.958
	excellent	15	31.93	10.96		
			Group B			
					F	p
MAS	good	6	50.18	8.50	0.353	0.706
	very good	11	51.00	9.48		
	excellent	10	54.00	9.55		
REL	good	6	61.50	15.93	0.327	0.725
	very good	11	62.55	11.75		
	excellent	10	66.10	10.89		
REA	good	6	36.33	11.29	2.591	0.096
	very good	11	30.36	17.13		
	excellent	10	19.70	14.24		

Table 4 shows the scores obtained on the Resiliency scale with regard to school success. In the subsample of DHH pupils, there were three pupils with good success, while in the subsample of typically developing pupils there were three of them with sufficient success. Their achievements aren't shown in this table because of the inability to compare it with the other pupils' results. Research results show that school success is significantly associated with personal resiliency both in the typical population and DHH pupils (Prince-Embury, 2011). What's more, some authors state that this is one of the key factors related to resiliency in DHH pupils (see Luft, 2011 for a review). In this study, no statistically significant differences were obtained within the MAS, REL, and REA scales, in any of the subsamples. The greatest differences between the samples were obtained within the REA scale, where the average score of the DHH with excellent success was 31.90, and among pupils of the typical population with the same success, the score was 19.70. This difference is statistically significant as T-test has shown ($t = 2.427$; $p = 0.023$). Based on the results presented in the table, it can be concluded that the level of resiliency increases with school success, which indicates the importance of school success in the level of resiliency.

Achievement on the Resiliency Scale with regard to the communication model

Table 5. *Achievement on the Resiliency scale with regard to the communication model*

	communication model	N	M	SD	t	p
MAS	gesture	12	51.67	12.70	0.472	0.673
	total	14	49.50	13.08		
REL	gesture	12	63.50	16.56	0.572	0.573
	total	14	59.93	15.26		
REA	gesture	12	35.42	13.28	0.914	0.370
	total	14	30.93	11.78		

Table 5 shows the results of pupils using a predominantly sign language and predominantly total communication model, whereas the results of pupils using a predominantly oral communication model were not considered because there were only four of them. On the MAS and REL scales, pupils who predominantly use the sign communication model achieved higher scores, while on the REA scale, pupils who predominantly use the total communication model performed better. In a study conducted by a group of authors (Johnson et al., 2018), it was found that most mental health professionals working with DHH persons stated that language and communication were protective factors in the development of resistance and trauma. Most parents of DHH children have good hearing. Only a few parents choose to learn sign language and expect their children to use oral speech in communication. Communication problems are most expressed in adolescence because conversations with family members, peers and other significant people in the environment become very important. Communication with parents can become difficult, and often the help of a professional is needed to overcome problems and misunderstandings. Deaf adolescents find it even more difficult to explain the nature of the changes they experience due to their poor language and speech development, and communication barriers leave room for mistrust. Deaf adolescents thus have the additional difficulty of not having an adult in the family to support them and facilitate their journey into adulthood (Luft, 2011).

CONCLUSION

The results of this study show that the level of personal resistance of the DHH pupils and of the typical population is approximately the same. A slightly lower level was obtained in the domains of *Optimism* and *Self-efficacy* within the MAS scale, *Social comfort* and *Tolerance* within the REL scale and *Recovery* within the REA scale. A lower level was also found within the REA scale for DHH pupils who achieved excellent school success, which requires further research on a larger sample. Individual factors such as age, gender, school success, as well as the way of communication among DHH pupils didn't prove to be significant factors for the level of resiliency, but these findings must be interpreted with caution given the limited sample size.

These findings open the door for further research as the Resiliency Scale can be used as a triage tool in a school setting to identify children with internalized and externalized behavioral problems in order to detect the problem in a timely manner and create conditions for its overcoming, with especially designed programs to improve resiliency (Prince-Embury, 2011). Social support, as well as access to material resources, play a significant role in resiliency development (Ungar et al., 2007). It would also be important to examine the role of the social environment in the development of resiliency of the DHH, primarily teacher support, both in schools for the DHH pupils and in inclusive schools. In the current educational settings, where the majority of cochlear implant pupils are enrolled in regular schools, it would be particularly important to assess their level of resiliency, as research indicates that children with cochlear implant have higher levels of confidence (Percy-Smith, Cay-Thomasen, Goodman, Jensen, & Thomsen, 2008).

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Theme 4

Approaches and Models for Adults with Disabilities

NEUROREHABILITATION IN PATIENTS WITH TRAUMATIC BRAIN INJURY

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SUMMARY

Patients with traumatic brain injury (TBI) may have significant cognitive deficit and rehabilitation is based on the improvement of remaining abilities aiming to bring the person closer to premorbid profile. The aim of this study was to compare attention, memory and constructive-praxis state between healthy individuals and TBI patients before and after 4-weeks of special neurorehabilitation therapy. The experimental group (E) consisted of 15 patients with brain injury, while the control group (C) consisted of 15 healthy subjects. The assessment instruments were the subtests of "Attention" and "Memory" tests, and performed before and after the 4-weeks-therapy (focus, attention transfer, memory, and constructive practice therapy). Descriptive statistical methods and two-factor-analysis of variance was used as analytical statistical methods, where one factor represented group affiliation and the other was measurement (before and after therapy). The difference significance was determined at the level of error probability of type I$\alpha = 0.05$ (statistically significant difference $p < 0.05$, highly statistically significant difference $p < 0.01$). Results showed that all groups had 15 respondent (10 men, 5 women), ages between 15 and 18 years. In all tests high statistically significant difference between E and C group was found on the first measurement. Statistically significant difference between subjects of both groups on the second measurement was also found. High statistically significant difference of the E group on the first and second measurement was found. It can be said that applied therapies were effective. However, patients demonstrated lower score on tests after therapy than their healthy matches, indicating that four-week-therapy is not sufficient and should be continued.

Key words**:** neurorehabilitation, brain injury, cognitive deficit

INTRODUCTION

Rehabilitation of patients with brain injuries in special education and rehabilitation (defectology) is oriented towards the problems of persons with disabilities, not methods of rehabilitation. Rehabilitation of these patients is based on residual abilities, cognitive and motor learning, adaptive, compensatory and substitution potentials, with the aim of limiting or completely eliminating deficits. So, therapy of brain injured patients in special education and rehabilitation is oriented towards raising those cognitive and motor functions that will enable patients to integrate into the family, educational, professional and social environment. The main goal of therapy for patients with brain injury is to bring them closer as much as possible to their premorbid personality profile.

The specific goals of therapy are: (a) motor deficit therapy (initiation, navigation, capture and constructive praxis); (b) cognitive deficit therapy (attention, learning, thinking and memory); (c) establishing a dynamic relationship and transferring the effect of motor function therapy on cognitive functions and vice versa; (d) therapeutic programs for each cognitive dysfunction include a link to motor dysfunctions; (e) motor dysfunction therapy programs are related to cognitive dysfunctions.

Brain injuries

Traumatic Brain Injury (TBI) is the most common cause of death and impairment of quality of life in young people. In the United States, over 1.5 million people suffer a brain injury every year, from which about 300,000 require hospital treatment. Therefore, the treatment of brain injuries requires considerable financial support and represents a significant burden on the financial budget of each state. Traffic accidents are the most common cause of head and brain injuries in young people, while falls from a height are the most common in people over 65 years of age (Thurman, Alverson, Dunn, Guerrero, & Sniezek, 1999).

This severe pathology is increasingly catching the attention of physicians, which can easily be seen when the term *brain injury* is typed into the medical database *PubMed*®. It can be seen that in 2017 there were over 4000 papers on this subject, while in 2018 there were about 3500 papers with a title containing this key term. TBI is defined as brain damage caused by an external force, which can be due to sudden accelerations or decelerations of the head and neck, direct blows to the head, blast injuries or penetrating injuries of a foreign body. An important feature of brain injury is temporary or permanent loss of brain function (loss of consciousness, amnesia, neurological deficit), while structural damage may or may not be seen by modern technologies (Ghajar, 2000).

The severity of TBI can be evaluated with different scales, and the most commonly used in clinical practice is the Glasgow Coma Scale (GCS), which classifies TBI into 3 main groups: mild, moderate, and severe brain injury. The Glasgow Coma Scale (GCS) is a scoring system for evaluating the state of consciousness in people who have suffered brain injury. It ranges from 3 (deepest coma) to 15 (normal state of consciousness). About 80% of TBI are minor injuries with a GCS between 13 and 15, and in the majority of cases doesn't leave any neurological consequence. However, between 15% and 30% of the TBI patients develop some neurocognitive and behavioral changes (Deneshvar et al., 2011; Ghajar, 2000). Moderate TBI involve a GCS between 9 and 13, and the patient is lethargic or stuporous. In severe TBI (GCS 3-8), the patient is comatose, does not open his eyes or perform orders. Patients with severe TBI are at high risk for secondary brain injury, resulting from hypotension, hypoxia and/or brain swelling. If the GCS is lower than 9, there is a direct linear association with poor patients outcome that includes severe neurological deficit, vegetative status, and even death (Mckee & Daneshvar, 2015).

TBI are divided into two groups with respect to the time of onset: primary and secondary. Primary TBI occur at the time of injury when the tissue and blood vessels are stretched, pressed, or ruptured, e.g. they are caused by a direct or indirect effect of mechanical force (due to linear acceleration/deceleration forces, rotational forces, blast injuries, blunt object strikes, or penetrating injuries such as a projectile, and often by a combination of these mechanisms). Secondary TBI occur at a delayed time, e.g. minutes, hours, or days after injury, and represent a complication of primary injury, resulting from complex pathological biochemical and cellular cascades activated by injury (mitochondrial dysfunction, increased glutamate secretion, increased free radical production, calcium and sodium influx in the neurons, brain tissue ischemia, hypoxia, brain swelling, and consequent increased intracranial pressure) (Park, Bell, & Baker, 2008). Primary TBI are generally definitive. Secondary injuries are often reversible and that is why they represent a potential target for therapeutic procedures in the treatment of TBI.

The morphology TBI classification is very complex and is often identified with craniocerebral injuries classifications, which in addition to brain injuries include injuries to the skull and soft tissues of the head (injuries such as fracture of the skull and acute subdural hematoma are often associated). TBI are divided into: open and closed TBI depending on skin integrity in terms of morphological characteristics (although some authors presume only brain tissue exposure as a criterion). Open injuries can be penetrating and perforating. Closed injuries are further divided into focal and diffuse. Focal injuries can be extra-axial and intra-axial, depending on whether the pathological substrate is in the brain tissue itself (intra-axial, e.g. contusion) or around the brain tissue and by its compressive effect causes damage (extra-axial, e.g. epidural hematoma). Focal brain injuries include brain contusions and intracranial hematomas (epidural, subdural, and intracerebral). Diffuse brain injury refers to widespread brain dysfunction, most often without visible macroscopic structural damage, although in some cases macroscopic substrate may be evident, such as in diffuse brain tissue edema after injury. Often these injuries occur at the same time, and classification is more the result of a systematic approach for the purpose of treatment according to good medical practice protocols (Đurović, 2013).

Traumatic brain injury consequences

TBI in survivors leaves significant consequences, even in patients with mild traumatic brain injury (mTBI) (Pavlović, 1999). Severe disability after TBI is found in 15-20 per 100000 people per year (Fleminger & Ponsford, 2005). Most of these patients will have a combined mental and physical disability after the injury. When it comes to moderate and severe TBI, personality changes, amnesic disorders, reasoning, apathy, motor, speech and epilepsy disorders are very common (Lindsay, Bone, Fuller, & Callander, 2010). About 90% of patients recover at least partially within the first 6 months, but some continue to recover for many years. Permanent disability is present in 10% of mTBI, 66% in moderate TPM, and 100% when it comes to severe TBI (Frey, 2003).

Mild traumatic brain injury

Mild traumatic brain injury has many different definitions, but most commonly is defined with the GCS score between 13 and 15 according to state of consciousness (Prince & Bruhns, 2017). Sometimes the term brain concussion is also used. By definition, there are no neurological consequences. Mild TBI results in cognitive, vestibular and psychiatric disorders. The most general disorder is slowing the speed and capacity of information processing (Ojile et al., 2006). In these patients, divided attention is problematic (performing multiple tasks at the same time), distractibility is enhanced, and patient may be confused in the acute phase. Usually, patients recover in the manner of few weeks, but in about 15% of patients the consequences are permanent (Røe, Sveen, Alvsåker, & Bautz-Holter, 2009). Neuropsychological examination shows disorders of attention, memory, speech, visuospatial gnosis, and abstract thinking (Pavlović, 1999). Patients are easily fatigued and dysphoric. Automated actions require a conscious effort. Post-concussion syndrome occurs in about 10-20% of patients with mild TBI, and it is characterized by chronic disorders such as headaches, neck pain, instability, dizziness, impaired attention and memory, dyspepsia syndrome, and depression (Alexander, 1995; Ruff, 2005).

Neuropsychological consequences

The neuropsychological consequences of TBI can be focal or diffuse and include deteriorated cognition, memory, personality, and social functioning (Pavlović, Ocić, Stefanova, & Filipović, 1994). Anterograde and retrograde amnesia can been maintained for some time (Wang & Li, 2016). Also, verbal functions recover faster while non-verbal functions recover for a longer period of time (Strub, Black, & Strub, 1988).

Prefrontal injuries are associated with dysexecutive syndrome, complex attention disorders, impaired instrumental activities of daily living, impaired social cognition, and impaired motor activity (Williamson, Scott, & Adams, 1996). Different speech disorders can occur in TBI: all types of aphasia, but also more subtle language disorders such as processing of complex verbal information, learning new information's and social functions (Gkoltsiou et al., 2008; Vas, Chapman, & Cook, 2015). In TBI visuo-spatial and visuo-structural disturbances are common (Ilie, Cusimano, & Li, 2017). Behavioral failures are mainly related to orbitofrontal lesions in the form of disinhibition, euphoria and loss of social norms and this lesion disrupt everyday life in great manner (Pavlović, Milović, Ocić, & Tomić, 2000).

Post-traumatic amnesia

Post-traumatic amnesia refers to declarative memory, namely the inability to remember new information (anterograde amnesia) and the difficulty of recalling already remembered information (retrograde amnesia) (Pavlović, 1999). The length of amnesia duration varies from case to case. In terms of retrograde amnesia, the amnesia period usually shortens and finally the patient can't remember only last 30 seconds before injury, when information was not transmitted into long-term memory. The period of anterograde amnesia varies, and this type of disorder is also characterized by poor strategies for remembering and recalling. Verbal memory is impaired in left-sided and spatial memory in right-sided lesions (HS, 1997).

Long-term consequences

Some disorders of memory may be permanent after TBI, especially since in the closed TBI, which is the most common, the temporal and frontal lobes, as well as the hippocampus are typically affected. Also the retrieval memory processes can be disturbed and working memory can be damaged. There are also frontal memory disorders that include disabled formulating strategies (Bigler et al., 1996).

Rehabilitation of cognitive and praxis dysfunctions in TBI patients - a theoretical approach

Anohin believes that no organization, no matter how extensive it may be in the number of constituent elements that make it up, can be called a self-regulatory system, if its functioning, that is, the interplay between the parts of that organization does not end with a useful result for the system and if there is no feedback to the managing center about the degree of usefulness of the results. He believes that within each functional system there is a possibility of extraordinary interchangeability, and mutual compensation of their effectors mechanisms. As a result, dropping out of one or more executable components from the machine, such a functional system can achieve a final adaptation result by introducing other components (Anohin, 1979). Luria believes that, in persons with brain injury, the intact parts of the brain are dynamically reorganized in the direction of performing functions in another way. He points out that the recovery of function in people with TBI occurs in the presence of "active exercises incorporated into the reeducation program". The basic principles of retraining (reeducation) are: (1) Formulation of a "restorative training" plan; (2) training the patient in the implementation of compensatory strategies (using the same functions in a different way); (3) the scope and content of restorative training must be elaborated (training tasks must be broken down into series of highly articulated skills and aptitude) (Luria, 1983).

The aim of this study was to compare attention, memory and constructive praxis state between healthy individuals and patients with TBI before and after 4-weeks of focus therapy, attention transfer therapy, memory therapy, and constructive praxis therapy.

METHOD

The experimental group (E) consisted of 15 patients with radiology confirmed brain contusion, while the control group (C) consisted of 15 healthy subjects. There were 10 men and 5 women in each group.

The inclusion criteria for the E group were: subjects had brain injury (as determined by the neurosurgeon); that there are no multiple skeletal bone fractures (as determined by the orthopedic surgeon); that there are indications for further neurological observation (as identified by the neurologist); that the patients are between 15 and 20 years of age of both sexes; that there were no developmental disorders in the subjects (as determined by taking a history from their parents). All patients had no neurological deficit in terms of extremity paresis or paralysis. C group consisted of healthy volunteers who were equal to members of the experimental group by gender, years of age, education level, school performance and occupation.

All E group subjects had brain contusion. According to the findings of the neurosurgeon 7 patients were operated, 9 patients had skull fracture, 7 subjects had brain edema, and 8 subjects had intracranial hemorrhage. All subjects sustained a brain injury in a car accident. All but one of the respondents were aware on the admission.

Each group had 15 respondents: 10 men and 5 women; 3 respondents were 15 years of age; 1 respondent was 16 years; 1 respondent of 17 years; 4 respondents aged 18; 1 respondent of 19 years and 3 respondents of 20 years.

The assessment instruments were the subtests of "Attention" and "Memory" tests (number memory test, orientation test, remembering time-distant events test, learning capabilities test, and the story recall test – all tests were from the "Mental Status Examination"). The results of each group respondents were calculated in relation to the maximum possible score of each individual subtest and the average achievement was calculated.

Constructive praxis was tested with subtests from the Mental Status Examination: "Picture copying" test and "Drawing on a command" test.

The measurement results in the surveys in all subtests are dichotomously categorized as "satisfactory" or "unsatisfactory".

Testing was performed before and after the therapy that consisted of focus therapy, attention transfer therapy, memory therapy, and constructive praxis therapy. Initial testing and therapy in E group started 7-10 day after injury. Therapy was conducted every day for four weeks.

Therapeutic tasks that related to focusing attention (focus therapy) consisted of requiring the patient to signalize: even numbers, odd numbers, and selected words that occur 6-7 times in literary content.

Therapeutic tasks related to attention transfer therapy required of patients the simultaneous enumeration of male and female names, followed by fruits and vegetables and finally domestic and wild animals.

In memory therapy tasks, we asked patients to remember the contents to which they were previously exposed and which are parts of their experiences. Memory tasks included remembering: a series of numbers, brief literary and simple visuals (photographs of things, animals and landscapes). Another element of this therapy was the time interval at which patients needed to memorize and repeat certain contents (short-term and long-term memory).

Constructive praxis therapy consisted of several tasks. In the first task, we asked patients to reconstruct photographs that were cut into 4 and then into 5, 6, and 7 sections. In the second task, it was necessary to imitate the construction made of cubes in the same way. We designed this task with 5 cubes at the beginning, and then we increased number of cubes and complexity of the task. The third task consisted of imitating models of triangles (12 triangles) in two sizes and two colors. Finally, patients were tasked with sketching simple three-dimensional drawings.

Frequencies and percentages were used as descriptive statistical methods. Two-factor analysis of variance was used as analytical statistical methods, where one factor represented group affiliation (E or C) and the other factor was measurement (before and after therapy. e.g. I and II measurement). The significance of the difference was determined at the level of error probability of type Ia = 0.05 (statistically significant difference $p < 0.05$, highly statistically significant difference $p < 0.01$). The results are presented in tables. Data were processed using the easy-R software system (EZR, version 1.41. 64-bit)®.

RESULTS

Table 1. *Respondents' achievements at Number memory test*

Group	Number memory test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	135	55	40.74	15	135	84	62.22
C	15	135	99	73.33	15	135	101	74.81

Tested differences on the subtest show high statistical significance between subjects of E and C group on the first measurement ($p < 0.01$); statistical significance between respondents of both groups on the second measurement ($p < 0.05$) and high statistical significance of the E group respondents on the first and second measurements ($p < 0.01$).

Table 2. *Respondents' achievements at Orientation test*

Group	Orientation test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	165	107	64.84	15	165	149	90.30
C	15	165	165	100	15	165	165	100

The intergroup differences on the first and second measurements are highly statistically significant ($p < 0.01$). There is a highly statistically significant difference in the E group subjects on the first and second measurements ($p < 0.01$).

Table 3. *Respondents' achievements at Remembering time-distant events*

Group	Remembering time-distant events							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	90	46	51.11	15	90	76	84.44
C	15	90	90	100	15	90	90	100

The intergroup differences tested on the first and second measurements are highly statistically significant ($p < 0.01$). The differences between the first and second measurements in the E group respondents are highly statistically significant ($p < 0.01$).

Table 4. *Respondents' achievements at Learning capabilities test*

Group	Learning capabilities test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	180	41	22.77	15	180	93	51.66
C	15	180	172	95.55	15	180	175	97.22

Intergroup differences of E and C group on the first and second measurements are highly statistically significant ($p < 0.01$). There is a highly statistically significant difference in the E group respondents on the first and second measurements ($p < 0.01$).

Table 5. *Respondents' achievements at Story recall test*

Group	Story recall test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	330	47	14.24	15	330	95	28.78
C	15	330	164	49.69	15	330	169	51.21

There is a highly statistically significant difference between the subjects of both groups on the first and second measurements ($p < 0.01$). There is also a highly statistically significant difference in the E group subjects on the first and second measurements ($p < 0.01$).

Table 6. *Respondents' achievements at Picture copying test*

Group	Picture copying test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	225	127	56.44	15	225	178	79.11
C	15	225	223	99.11	15	225	224	99.55

The intergroup differences in the study groups on the first and second measurements are highly statistically significant ($p < 0.01$). There are highly statistically significant differences in the first and second measurements in the E group patients ($p < 0.01$).

Table 7. *Respondents' achievements at Drawing on a command test*

Group	Drawing on a command test							
	Measurement							
	I				II			
	N	n	m	%	N	n	m	%
E	15	135	65	48.14	15	135	104	77.03
C	15	135	132	97.77	15	135	134	99.25

The intergroup differences in the study groups on the first and second measurements are highly statistically significant ($p < 0.01$), also there are highly statistically significant differences in the first and second measurements in the E group patients ($p < 0.01$).

DISCUSION AND CONCLUSION

Based on the results obtained regarding attention and memory, we can conclude that the therapy we used was effective and that patients achieved significant recovery. An integral part of this finding is that their lagging behind their healthy peers is also significant and that four weeks of therapy is not enough. We can very likely conclude that the recovery of attention led to the recovery of memory, most notably memory for orientation and memory of distant events, and significantly less memory - new learning abilities and memory - a story to repeat. Patient achievement in the domain of cognitive function can be interpreted by complexity of these functions. These findings are in accordance with other studies. Lesniak et al., (2019) showed that a comprehensive program of cognitive rehabilitation may improve memory and attention, as well as cognitive functioning on daily basis in patients with severe or moderate TBI (Leśniak, Iwański, Szutkowska-Hoser, & Seniów, 2019).

Results related to therapy of constructive praxis indicate significant patient recovery and effectiveness of therapy. It is noticeable that patients performances are still significantly behind their healthy peers and that therapy should be continued. Patient outcomes are significantly more consistent after treatment compared to pre-treatment results. This information can be interpreted by the relative closeness of the ability of constructive praxis - drawing on a command and constructive praxis - picture copying.

Even though the apraxia incidence after TBI is considerable, the evidence on treatment and recovery is very obscure. There are several reasons for this: (1) apraxia patients often seem to be unaware of deficit and hardly ever complain; (2) recovery from apraxia is sometimes considered to be spontaneous and treatment is not necessary; (3) some studies showed that apraxia occurs when performance is requested of patients in testing situations and that correct performance is displayed in non-testing situations (Leśniak et al., 2019). These points of view probably threw apraxia problems into the scientific shadow which is why the number of studies on this topic is very small. However, available studies were analized by EFNS members of the task force on cognitive rehabilitation, and their results clearly suggest that treatment of apraxia should be part of the rehabilitation program after TBI. Our findings also suggest that therapy of constructive praxis leads to significant patient recovery (Cappa et al., 2005).

There is a clearly need for adequately designed, large, randomized studies in this area of rehabilitation after TBI, which should take into account specific problems such as patient heterogeneity and treatment standardization, after which better guidelines would be used in every day clinical practice.

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INTERVENTIONS FOR RETURN TO WORK OF PERSONS WITH SPINAL CORD INJURY

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SUMMARY

The return to work of persons with spinal cord injuries is very important for their mental and physical health, economic status, social integration and quality of life. The process of return to work or employment is complex and involves considering many personal factors, injury-related and contextual factors that can make predicting return to work success difficult. On the other hand, there are factors that can contribute to the success of this process. The purpose of this paper is summarizing scientific knowledge on return to work of persons who experienced spinal cord injury based on literature review. Analyzing of the recent research, it was discussed of the effectiveness of interventions for return to work in persons with spinal cord injury. Consideration was focused on vocational rehabilitation intervention as general and on early vocational rehabilitation, multidisciplinary team approach, coordination return to work and workplace intervention as specific intervention in frame of vocational rehabilitation. It can be concluded that all the mentioned interventions have a positive impact on the return to work of persons after spinal cord injury, directly by shortening the time of return to work, and on indirectly way leading to better mental health, social integration, self-confidence and motivation.

Key words: intervention, spinal cord injury, workplace, multidisciplinary team, return to work coordination

INTRODUCTION

The primary goal for working age persons with acquire disabilities is job retention and for those who have left their jobs due to their disability is return to work. Many will be able to achieve this goal, but for someone it will be impossible. Return to work is important for them because work gives them meaning and purpose.

The International Labour Organization adopted the Code of Practice on Managing Disability in the Workplace in 2001 and return to work is defined as "the process by which a worker is supported to resume work after being absent due to injury or illness" (p.5).

The phenomenon of return to work or employment involves many personal, injury-related factors, workplace factors and contextual factors that make predicting return to work success difficult.

In generally, there is evidence on the benefits of employment for persons with disabilities concerning better physical and psychological health, financial, an increased social integration, improved quality of life, enhanced self-confidence, expanded social network, and a sense of community as well (Lindsay, Cagliostro, Abarico, Mortaji, &

Karon, 2018; Murphy, 2009; The Royal Australasian College of Physicians & The Australasian Faculty of Occupational and Environmental Medicine, 2011).

Literature points on the benefits of hiring people with disabilities for employer by increase attention paid to the role of people with disabilities in the workplace. In summary, benefits included improvements in profitability, competitive advantage, inclusive work culture, and ability awareness (Lindsay et al., 2018).

On the other hand, worker disability and absence from the workforce is associated with significantly diminished economic, health-related and psychosocial wellbeing (Waddell & Burton, 2006).

Higher levels of industry development have led to increase in the number of persons with spinal cord injuries. Every year, around the world, between 250 000 and 500 000 people suffer a spinal cord injury (WHO, 2013). Traffic accidents are the most common cause of injuries, but including high-altitude crashes, work-related accidents, sports injuries, stabbing with sharp objects, or bullet wounds (Bogdanov, 2009). All previous injuries are traumatic in nature, and more of 90% of spinal cord injuries are in this group (WHO, 2013). Other group includes non-traumatic injuries as causative agents like cancer, infections, vascular diseases of the spinal cord, and diseases of the intervertebral disc (Van den Berg, Castellote, Pedro-Cuesta, & Mahillo-Fernandez, 2010).

Spinal cord injuries are more common in adults than in children, and when compared to sex, they are more common in men than in women, with a 2:1 ratio (WHO, 2013).

This type of injury occurs unexpectedly and the person faces major changes in all areas of life in the physical, emotional and spiritual sphere (Carvalho, 2002 cited in Mendonça Pinto Amaral, 2009). The person begins to live in a new reality where roles and activities need to change.

Meaning of work after spinal cord injury in existing literature is described in terms of re-developing a sense of self, re-establishing place in the community and regaining economic self-sufficiency. In addition, the varied meanings of work after spinal cord injury may be used in rehabilitation programs to explore ideas about work, the types of work they wish to pursue, and the ways in which work may be meaningful for persons with spinal cord injury (Ullah, Fossey, & Stuckey, 2018).

Chapin and Holbert (2010) found that employed persons after spinal cord injury have more positive feelings, greater life satisfaction and a higher subjective quality of life than their unemployed counterparts. Furthermore, engaging in paid work is a way to be productive and because of that reinforcing self-efficacy and self-esteem (Clifton, 2010).

Some authors looked at the factors that positively affect return to work/employment after a spinal cord injury focusing on demographic variables, functional independence, pre-injury occupation and vocational training after injury.

Jang, Wang, & Wang (2005) found that education and functional independence were associated with employment. Persons with a high school education had higher chance of returning to work. Further, significantly associated with employment included marital status, with marriage having a favorable influence, age at injury, with age below 25 years being favorable. Persons with greater degree of functional independence and ability to use public or private transport independently had a 2.7-fold higher chance of returning to work than those unable to travel independently. Other factors significantly associated with employment included pre-injury occupation and vocational training after injury.

Based on the above, the importance of returning to work of persons with spinal cord injury is indisputable, so the purpose of this paper is summarizing scientific knowledge on the return to work of persons with spinal cord injury based on literature review. Through the analysis of the results of recent researches, the effectiveness of interventions for return to work in persons with spinal cord injury was discussed. The consideration is focused on vocational rehabilitation interventions, early vocational rehabilitation intervention, multidisciplinary team approach in vocational rehabilitation, coordination return to work and workplace intervention.

Interventions associated with return to work

In generally, return to work interventions require the work environment and concerted action by the various partners, the health care services, the welfare system and employer (OECD, 2010). Several intervention components are found to be essential for facilitating return to work, including centralized coordination of the employees return to work, formal individual psychological and occupational interventions, workplace-based interventions, work accommodations, contact between various stakeholders and interventions to foster concerted action (Briand, Durand, St-Arnaud, & Corbiere, 2008).

Vocational rehabilitation intervention

Vocational rehabilitation including set of activities focused on return to work or employment of persons with disabilities. The definition of vocational rehabilitation that includes all these elements though not explicitly provided by Chan, Reid, Kaskel, Roldan, Rahimi, & Mpofu (1997) and defined it as a dynamic process consisting of a series of actions and activities that follow the logical, sequential progression of services related to the total needs of the persons with disability. The process begins with the initial case finding or referral, and ends with the successful placement of the individual in employment. Many activities and developments occur concurrently and overlapping in time frames during this process (p. 312).

Vocational rehabilitation is process and includes series of services:

- assessment, program evaluation, and research,
- goal setting and intervention planning,
- health advice and promotion, in support of returning to work,
- self-management of health conditions,
- adjustments to the impact of a disability,
- case management, and service co-ordination,
- psychosocial interventions,
- career counseling, job analysis, job development, and placement services,
- functional and work capacity evaluations (Vocational Rehabilitation Association of the UK, 2016).

While general rehabilitation focuses on facilitating the functional recovery from injury or illness, to its original state as possible, vocational rehabilitation objective is restoring capacity for work and consists of a range of techniques which could effectively help disabled workers return to work, job retention, or to find a new employment. The benefits of vocational rehabilitation for injured people are mitigating work disability, expedite return to meaningful employment, minimizing lost workdays, increasing the person`s productivity, reducing early retirement, and restrict the welfare cost (Disler, 2001).

Arango-Lasprilla, Cardoso, Wilson, Romero, Chan, & Sung (2011) examined effect of receiving services from state vocational rehabilitation agencies on employment outcomes of person with spinal cord injury. Observational analyses of vocational rehabilitation interventions have found that on-the-job training, job search assistance, job placement assistance, on-the-job support, maintenance services, assistive technology and 'other services' were significant predictors of successful employment outcomes.

There is evidence on vocational services that actively engage persons with spinal cord injury in job seeking and providing on-the-job support that are more effective than general vocational counseling that involves only job preparation. Ottomanelli, Barnett, Goetz, & Toscano (2015) examined the association of specific vocational service activities as predictors of employment that actively engage persons with spinal cord injury. Primary activities recorded were vocational counseling (23.9%) and vocational case management (23.8%). Research included 81 veterans with spinal cord injury. As expected, job development and employment supports were the most time-consuming activities. Though the amount of time spent in weekly appointments did not differ by employment outcome, participants obtained competitive employment averaged significantly more individual activities per appointment. Further, participants who received job development or placement and employment follow-along or support services are more likely to be employed but if they received only vocational counseling was less likely to occur it. Community-based employment services, including job development or placement and employment follow-along or supports as part of a supported employment model, were associated with competitive employment outcomes. Office-based vocational counseling services, which are common to general models of vocational rehabilitation, were associated with a lack of employment.

The interest of some authors was focused on examining the relationship between components of vocational rehabilitation services, demographic factors and work disincentives employment outcomes.

Marini, Lee, Chan, Chapin, & Romero (2008) examined this relationship in over 10 901 persons with spinal cord injury whose cases were closed either as employed (54%) or not employed (46%) by state vocational rehabilitation agencies. They found that job placement assistance, work disincentives, and case expenditures as the most important predictors of employment outcomes. In addition, physical restoration, substantial counseling, and assistive technology services all led to positive employment outcomes. Importantly analysis indicated that demographic variables interacted with rehabilitation services to affect employment outcomes. Authors concluded substantial counseling, assistive technology, and job placement and support services are important to the return-to-work success of persons with spinal cord injury.

Multidisciplinary team approach

The success of vocational rehabilitation does not depend only on the application of various interventions, but also the experts who participate in their performance have a significant role. Therefore, Escorpizo, Reneman, Ekholm, Fritz, Krupa, Marnetoft et al., (2011) defined it as

multi-professional evidence-based approach that is provided in different settings, services, and activities to working age individuals with health-related impairments, limitations, or restrictions with work functioning, and whose primary aim is to optimise work participation (p. 130).

Injury outcomes are different and experts must have basic knowledge related to injury consequences, necessary rehabilitation provision and other kind of help adapted to time and stages of injuries (Odović & Ilić-Stošović, 2016).

Multidisciplinary team involve many professionals and may differ depending on the individual programs but many include physician, nurse, physiotherapists, occupational therapists, psychologists, social worker, vocational trainers, job counselors, teachers, case-managers, job placement agencies (Cobble, 1990; Gobelet, Luthi, Al-Khodairy, & Chamberlain, 2007). Multidisciplinary teams are used both as a working model and a model of collaboration in vocational rehabilitation. There are different teams in vocational rehabilitation, for example clinical teams and intervention teams. These teams may be multi-professional or inter-professional and sometimes even trans-professional, depending on the intensity of the contacts between the members and how dependent they are on each other (Andersson, Ahgren, Axelsson, Eriksson, & Axelsson, 2011).

The different professionals have complementary competences and they bring their expertise to the team. Team has many benefits for both patients and the health professionals working in the team. Some of them are improving health outcomes and increasing customer satisfaction as well as more efficient use of resources and greater job satisfaction of team members. Earlier literature cites the three principal benefits of the multidisciplinary team approach that make it more effective than other processes for persons with disabilities and these are:

1. Allows persons with disabilities to participate in a goal oriented comprehensive interdisciplinary and coordinated rehabilitation process.
2. Helps ensure that person's rehabilitation plans will be individually tailored and coordinated.
3. Persons with disabilities are involved in the planning and implementation of their own individual programs (Hope et al., 1986).

Evidence of the benefits of applying a multidisciplinary rehabilitation program in vocational rehabilitation compared with treatment as usual is also available in recent literature. Braathen, Veiersted, & Heggenes (2007) conducted study to evaluate potential effects of a vocational multidisciplinary rehabilitation program on group of 183 patients on long-term sick leave (average 12.2 months). The effects of the treatment were compared with a 96 persons recruited from the national sickness insurance record of patients on sick leave of 6 – 12 months duration (average 11.5 months). Perceived work ability, return to work, background factors and psychosocial aspects of work were assessed at the start and after 4 months. The multidisciplinary rehabilitation programme included physical activity, education, cognitive behavioural modification and workplace-based interventions. Work ability of the intervention group after 4 months improved significantly (80% achieved return to work) compared with the control group (66%). Regardless of group, individuals with a concrete goal of return to work at baseline showed a significant increase in work ability after 4 months. Patients with mainly psychological work demands showed higher work ability after 4 months. The return to work after 4 months was predicted by good work ability at baseline, improved work ability at follow-up, improved work motivation at follow-up and increased rumours of change in the workplace all predicted return to work. The improved work ability in the intervention group supports the use of the multidisciplinary rehabilitation programme.

Barriers to the multidisciplinary team approach can be passive, domineering, or unprepared team members who inhibit the overall team process, as can personality conflicts and biases among team members. Unless there is good communication between all team members, benefits are lost through misunderstandings and mixed messages that go into the ultimate decisions regarding the client’s future (Hope et al., 1986).

Further, with all of these different actors, there is an obvious risk of service fragmentation in vocational rehabilitation or there may be a costly duplication of services. In order to avoid fragmentation, there have been initiatives to improve collaboration between organizations involved in vocational rehabilitation (Andersson, Ahgren, Axelsson, Eriksson, & Axelsson, 2011).

In addition to these barriers that can cause inadequate functionality of a multidisciplinary team, there is the question of team size when it comes to persons with spinal cord injuries and the effect of team size on patients’ active participation in their treatment sessions. Dijkers and Faotto (2012) considered the size of teams and the its effect on patients’ active participation during treatment sessions. They concluded the large size of the rehabilitation team should be reason for concern about continuity of care, unless it can be shown that formal and informal mechanisms of communication between staff members are available that counteract the problems inherent in conveying information on a patient’s status, progress, and needs to a team numbering in the dozens. Treatment of a single patient by dozens of clinicians may not mean lack of familiarity of patient and therapist with one another or the possibly weak therapeutic alliance does not affect the patients’ active participation in their sessions.

Odović (1998) believes that the accompanying difficulties that occur after spinal cord injury and paraplegia lead to a certain degree of social disintegration, which is one of the reasons for the multidisciplinary approach in the rehabilitation of these persons.

Barclay, Lalor, Migliorini, & Robins (2019) conducted qualitative study to describe and compare models of service delivery intended to support community integration in the immediate period following inpatient rehabilitation for spinal cord injury. A variety of models aimed at supporting community integration in the immediate period following inpatient rehabilitation for spinal cord injury were found. Multidisciplinary staffing and involvement of peer mentors was common to all services. The importance of vocational rehabilitation was acknowledged by all participants, although the approaches taken to this varied. Telehealth has the potential to assist in self-management, particularly for patients who live a long distance from the spinal unit or are confined to the home for health reasons, and could be further developed.

Early vocational rehabilitation

Vocational rehabilitation programs can be involved, parallel, throughout the process of returning to the labour market after an injury and should be an integral part of all good clinical and workplace management and is not necessarily a separate, second-stage intervention (Waddell, Burton, & Kendall, 2008). Therefore, vocational rehabilitation may be used synonymously with either clinical rehabilitation services or any other types of interventions involved in the community settings such as work disability prevention, prevention of job loss, or work reintegration (Hou, Chi, Lo, Chou, Kuo, & Chuang, 2017).

There are still opinions that vocational intervention is inappropriate in the primary rehabilitation phase due to the significant physical and psychological adjustments of person after injury. Thus vocational intervention is typically delivered post-discharge through referral to disability services (Bloom, Dorsett, & McLennan, 2017).

Early vocational rehabilitation interventions targeting individuals soon after injury have shown potential for enhancing post-injury labour force participation (Middleton, Johnston, Murphy, Ramakrishnan, Savage, Harper et al., 2015).

Odović (2005) suggests, when it is possible, vocational rehabilitation process should be start during medical rehabilitation services. In that light it is important ensure cooperation between institution for medical rehabilitation services and vocational rehabilitation institution. Furthermore this cooperation would allow identification of persons who need career orientation and vocational training, medical counseling during vocational rehabilitation process as well. If it is necessary in this way, it would assure purchasing of orthotic or prosthetic device.

Rate of attainment of employment has traditionally as the primary outcome measure of return to work programs for persons with spinal cord injury. Employment rate are different between countries due to various cultural, economic and legislative environments. Worldwide mean return to work rates for people with catastrophic injury are approximately 30-40%. Internationally, the best return to work rates reported for spinal cord injury in Switzerland and Sweden (Piccenna, Pattuwage, Romero, Lewis, Gruen, & Bragge, 2015). It can take years for a person to obtain new employment following a spinal cord injury, with the interval between onset of spinal cord injury and paid employment being approximately four or five years (Berkowitz, 1998; Krause, 2003; Krause, Terza, Saunders, & Dismuke, 2010).

Early intervention is among the factors frequently associated with more positive vocational outcomes, with rehabilitation services proving to be more effective when both medical and vocational rehabilitation overlap (Chamberlain, Moser, Ekholm, O'Connor, Herceg, & Ekholm, 2009; Langman, 2011).

Hilton, Unsworth, Murphy, Browne, & Oliver (2017) explored the longitudinal outcomes for people who received early intervention in vocational rehabilitation and examined the relationships between contextual factors and employment outcomes over time. Ninety-seven participants were recruited and 60 were available at the final time point where 33% had achieved an employment outcome. Greater social participation was strongly correlated with wellbeing and reduced anxiety, depression and pain at the final time point. Education status, relationship status and subjective wellbeing increased significantly the odds of being employed at the final time point. Early intervention in vocational rehabilitation shows promise in delivering similar return-to-work rates as those traditionally reported, but sooner.

Middleton, Johnston, Murphy, Ramakrishnan, Savage, Harper, and others (2015) conducted a longitudinal study regarding the application of new early vocational rehabilitation programme (called In-Voc) for persons with spinal cord injury and summarized early vocational outcomes. This meant vocational rehabilitation was provided in conjunction with their regular inpatient rehabilitation programs. In-Voc rehabilitation consultants worked individually with inpatients, exploring their vocational options and goals with the aim to increase psychosocial well-being and return-to-work rates. The In-Voc programme was relatively short in duration (average 11 weeks, range 3-39 weeks) with a average total of 9.1 h of service delivered per partcipant. The program included 100 adults with spinal cord injury. In-Voc was offered to all inpatients within the first 6 months of acquired spinal cord injury. At case closure (average 3 weeks post-discharge), 34.5% of participants were in paid employment (7% full-time, 8% part-time, 7% on sick leave, and 12% working with hours unknown), 36% were unemployed (6% seeking work, 16% not seeking work, 14% job seeking status unknown), 13% were students or in-training, and 17% were in vocational rehabilitation. Based on result authors suggests that implementing an early vocational rehabilitation programme with individuals in the hospital setting is feasible and has good potential for enhancing post-injury labour-force participation.

Considering that the results of the implementation of the In-Voc program showed a positive impact on the return to work of people with spinal cord injuries, its advantage was considered from the point of view of health professionals. Johnston, Ramakrishnan, Garth, Murphy, Middleton, & Cameron (2016) conducted a qualitative study with the determine the critical elements of the In-Voc programme, and whether it was perceived as successfully implemented in the hospital setting. Three key programme characteristics were identified: flexibility, coordinators working on the ward, and good communication between all staff. Authors concluded that early vocational rehabilitation was perceived as appropriate and successfully implemented in the spinal injury unit in-patient setting, addressing an existing gap in patient care. The In-Voc programme was seen to assist patients identify the possibility of returning to work or education.

Some evidences showed that early vocational rehabilitation intervention results in feelings of hope and encourages patients to see the possibility of returning to work or education very early after injury. Ramakrishnan, Johnston, Garth, Murphy, Middleton, & Cameron (2016) conducted pilot early-intervention vocational rehabilitation programme over a 2-year period. Thirteen participants aged from 19 to 60 years with varying levels spinal cord impairment and vocational backgrounds were interviewed from 7 to 21 months post injury about the timeliness, perceived value, and critical elements of the early intervention. From perspectives of persons with spinal cord injury, vocational rehabilitation delivered during inpatient rehabilitation appears appropriate, important, and valuable. Emerging themes include sense of direction and distraction, advocacy, and support, with hope (early after injury) emerging as the overarching theme. Criticisms voiced about the program were that it was offered too early in the intensive care unit and there were competing interests and information overload in the early recovery phase.

Return to work coordination

There is a trend in many countries towards integrating health and social services due to complaints about health system weaknesses and individual errors. One way to overcome this is to connect functions, institutions and professions to improve the health system. The drivers of reform are similar, namely demand (demographic and epidemiological changes, rising expectations of the population and patients' rights) and supply (the development of medical technology and information systems and restrictions from economic pressures) (Gröne, Garcia-Barbero, & WHO, 2001).

Models of coordinating services vary by country, and the difference is in the service integration strategy. In that sense, when activities take places in a hierarchical structure between organizational units on different levels within an organization it is vertical integration, but when activities take places in organization or units on the same hierarchical level it define as horizontal integration (Kärrholm, 2007).

Return to work coordination run under a variety of names, such as case management, integrated care or collaborative care (Vogel et al., 2017) and other terms as shared care, transmural care, intermediate care, seamless care, disease management, continuous care, integrated care pathways and integrated delivery networks (Gröne, Garcia-Barbero, & WHO, 2001).

WHO The Regional Office for Europe (2016) use term integrated care and define as coherent set of methods and models on the funding, administrative, organizational, service delivery and clinical levels designed to create connectivity, alignment and collaboration within and between the cure and care sectors. The goal of these methods and models is to enhance quality of care and quality of life, consumer satisfaction and system efficiency for people by cutting across multiple services, providers and settings. Where the result of such multi-pronged efforts to promote integration leads to benefits for people, the outcome can be called integrated care (pp. 3-4).

The return to work coordination vary in content, duration settings and team members. Its include interventions like medical interventions, occupational therapy, physiotherapy, psychological therapy, social therapy, workplace ergonomics, and education. All interventions are adapted to the individual`s needs (Vogel et al., 2017).

On the basis of data from published research there is a less of research concerning return to work coordination but there is some evidence in support of return to work coordination or case management interventions at spinal cord injury.

Some authors evaluated aggressive collaborative approach for returning clients with new spinal cord injuries (King, Emery, Warren, & Landis, 2004). It was innovative case management program, which included support while individuals returned to the community after discharge from inpatient rehabilitation. This collaborative approach integrated vocational services and the case management program to assist clients in their plans to return to the work force. After 1 year, 17% of individuals had returned to work (approximately equal to the rate from the National Spinal Cord Injury Statistical Center) while 32% had begun educational training (compared with 15%).

Psychotherapeutic interventions appear effective interventions aimed at improving employment outcomes for physical and spinal cord injury (Trenaman, Miller, Escorpizo, & SCIRE Research Team, 2014).

Cancelliere and colleagues (2016) conducted a best evidence synthesis of systematic reviews on factors affecting return to work after injury or illness. Many interventions, especially those involving a return to work coordination, were associated with positive return to work outcomes, including multidisciplinary, occupational and care training, education, psychological, and outpatient interventions/comprehensive treatment. Stakeholder participation and communication, include supervisor and employee, worker and the workplace, and the healthcare provider and the workplace, as well as a meeting stakeholders together. Additionally, early intervention, started within the first 6 weeks, was connected to positive return to work outcomes.

Another one systematic review of studies describing a rehabilitation intervention enhancing employment following spinal cord injury was performed focusing on primary outcomes, the employment rate and duration of employment but on time of starting and the frequency of applying interventions. Roels, Aertgeerts, Ramaekers, & Peers (2016) mention that interventions can be carried out at a hospital and/or a community setting and an in-or outpatient setting. They divided interventions into: physical interventions, educational interventions, environmental interventions, vocational interventions or multidisciplinary interventions being a combination. It is noticeable that the time of starting the interventions varies extremely ranging from starting on the first day after sustaining a spinal cord injury up to a maximum of 34 years after spinal cord injury. Also the frequency of the interventions varies from daily to monthly. The team members of the different interventions are very diverse being either individuals or a multidisciplinary team and either linked to a hospital setting or a community setting. Finally included 15 studies but they took in account only one randomized controlled trials that was of sufficient quality. It included 201 patients and describing an intervention over 1 and 2 years. In this study, the employment rate was 26% after 1 and 31% after 2 years for competitive work, compared with 10% in the treatment as usual-intervention site control group and 2% in the treatment as usual observational site after 1 and 2 years. They stated that other studies were of low quality and describe higher employment rates from 36 to 100%.

Workplace intervention

Workplace is all the places where people in employment need to be or to go to carry out their work and which are under the direct or indirect control of the employer (ILO, 2001). Workplace adaptation is one of the most important conditions for including persons with acquired disabilities in regular employment or return to work.

Earlier literature indicates that people with spinal cord injuries are able to engage in competitive employment if appropriate adaption are provided to meet their needs such as workplace modification. Dowler, Batiste, & Whidden (1998) state that nearly threequarters of individuals require some form of adaption to maintain or improve their productivity. Inge, Wehman, Strobel, Powell and Todd (1998) spoke about the use of efficient assistive technology as one of the challenges that affect employment success.

Odović (2010b) also states that the adjustment of the workplace is one of the most important requirements for the inclusion of persons with disabilities in employment in the open economy. This includes access to assistive technology, different types of public funds, flexible working hours and adaptation of work tasks. Assistive technology tools are often used in restructuring and adapting the place where professional training and work of persons with disabilities is performed. In that sense, the author believes that the possibilities of personal independence and employment of people with disabilities, thanks to today's development of technology, are almost unlimited.

A study by Schönherr, Groothoff, Mulder, Schoppen, & Eisma (2004) suggests that for one-third of the 49 respondents (included in the survey), professional retraining was successful because they found employment. In most work situations, modifications have been made such as job adaptation and reduction of working hours.

In seeking to facilitate return to work or job retention by a employee with acquired disability, employers should be aware of the range of possible options:

- the employee may be able to return to the same job as before, with no changes,
- some adjustments may be required to the job itself, to the workstation or the working environment,
- it may be necessary for the person to move to a different job in the workplace (ILO, 2001).

Krause (2003) stated that there are two general way to employment after spinal cord injury. The first, fast way, where people return to their pre-injury job or pre-injury vocation and second, a slower way, that is generally associated with needs for further reeducation and training. Working to return the person to the pre-injury job or to a position related to their pre-injury occupation may substantially shorten the interval to return to work. In cases where this is not possible, counselors must work with individuals to understand the timeline of return to work and identify realistic educational goals that fit both the individual's interest pattern and post-injury abilities.

Physical limitations imposed on a person due to a spinal cord injury can sometimes interfere with the performance of work tasks. Job adaptation, however, can solve many problems in performing work tasks and enable these individuals to be capable and productive workers (Odović, 2012).

Workplace intervention may be required to the workplace to enable the worker with a disability to perform the job effectively, to the tools and equipment to facilitate optimal job performance, to review the job description and make changes – for example by deleting a part of the job which the person is unable to perform and replacing this with another task or tasks (ILO, 2001), to the changes in the work organization (including working relationships), to the working conditions or work environment, and occupational case management with active stakeholder involvement of (at least) the worker and the employer (Williams-Whitt, Bültmann, Amick, Munir, Tveito, Anema, & Hopkinton Conference Working Group on Workplace Disability Prevention, 2016).

Cullen, Irvin, Collie, Clay, Gensby, Jennings, and others (2018) found strong evidence for the effectiveness of workplace interventions at least in two of three different areas:

- provided with health services, either at work or in settings linked to work aimed at restoring function (physical therapy, occupational therapy, psychological therapy, medical assessments or exercises),
- support that including return to work planning and coordination for example case management, return to work plans, or improving communication between the workplace and health-care providers,
- the work modification in the form of work accommodation, ergonomics or other worksite adjustments, and supervisor training on work modification.

Authors indicate the grouping or packaging of interventions from the different domains makes them effective in a way that stand-alone interventions are not.

Recent studies have focused on specific workplace factors that impact work outcomes. Supervisor responses have consistently been shown to be an important determinant of return to work outcomes. There was strong evidence that work disability duration is significantly reduced by work accommodation offers and contact between healthcare provider and workplace; and moderate evidence that it is reduced by interventions which include early contact with worker by workplace, ergonomic work site visits, and presence of a return to work coordinator. For these five intervention components, there was moderate evidence that they reduce costs associated with work disability duration (Franche, Cullen, Clarke, Irvin, Sinclair, Frank, & The Institute for Work & Health, 2005).

CONCLUSION

Each of the considered interventions has a positive impact on returning to work after a spinal cord injury. Effects range from direct benefits such as early return to work after a spinal cord injury to indirect effects that include better mental and physical health, improved social integration, greater self-confidence and motivation. Interventions in vocational rehabilitation, in general, have a more significant effect if two or more interventions are delivered in parallel compared to the job preparation itself. Community-based employment services are better than office-based vocational counseling and are associated with a higher employment rate. In addition, a multidisciplinary team approach contributes to a holistic view of a person's abilities and the development of a comprehensive rehabilitation program, early vocational rehabilitation services delivered in inpatient settings create a sense of perspective and recover work ability faster, while workplace intervention, especially accommodation and supervisor support have shown significant impact and more frequent return to work than usual. Coordinated work of health and social institutions with participation and direct communication between different stakeholders opens the perspective for more efficient provision of services in the returning to work process.

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CHARACTERISTICS OF CERTAIN ASPECTS OF SOCIAL PARTICIPATION OF PERSONS WITH RHEUMATOID ARTHRITIS

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SUMMARY

Patients with rheumatoid arthritis have noticed the change in their lives, in domains of physical health, in their independence degree, in their participation in everyday life and in their ability to work. These patients daily encounter the characteristic symptoms of damage caused by arthritis, as well as the impact of the disease on socioeconomic status, employment and life habits. The onset of symptoms in rheumatoid arthritis is characteristic for a life period when a person is expected to be very engaged in his/her workplace, family environment, leisure activities, as well as in developing social contacts and social participation.

The aim of this research is to evaluate characteristics of certain aspects of social participation of persons with rheumatoid arthritis, by determining the importance of participation in diverse roles and the effects of restrictions in role participation, comparing the group of rheumatoid arthritis patients with the control group from general population. The sample consisted of 28 subjects with rheumatoid arthritis and 37 subjects from the control group. The study groups did not differ in gender, age, place of residence, educational, work, family and marital status and in the level of physical activity. In order to determine the importance of participation in diverse roles and the effects of restrictions in role participation the Importance of Participation in Diverse Roles and Restrictions in Role Participation Subscales within the Modified Social Role Participation Questionnaire, (Modif. SRPQ, Gignac et al., 2011) were used. The Importance of Participation in Diverse Roles Subscale in our research had a satisfactory (Cronbach's alpha coefficient was 0.71), and the Restrictions in Role Participation Subscale had good internal consistency (Cronbach's alpha coefficient was 0.86).

The results obtained in this study show that there are no statistically significant differences in the perception of the importance of participation and the participation in diverse roles between persons with rheumatoid arthritis and the control group persons, except in the domain of offspring relationships, where the significance of these relationships is lower in persons with rheumatoid arthritis than in persons from the general population. However, the importance of restrictions in diverse role participation is statistically significantly more pronounced in the group of rheumatoid arthritis subjects in the domains of hobbies, in community activities, social events, travel and vacations, daily contacts, but also in overall community activities. Thus, physical restrictions significantly limit the social participation of persons with rheumatoid arthritis. Regarding the association between demographic variables and the participation of persons with rheumatoid arthritis in diverse roles, the presence of restrictions associated with increased unemployment, i.e. decreased work engagement, was shown to be more frequent, while other variables were not related to the achievement of the subjects in the Importance of Participation in Diverse Roles and Restrictions in Role Participation Subscales.

The findings of this research may be of use to practitioners working directly with people with RA in the rehabilitation process. On the other hand, these findings could serve as a starting point for future studies focusing on the issue of social participation for persons with RA.

Key words: social roles, restrictions, social contacts, social environment, rheumatic diseases, participation, inflammatory rheumatism

INTRODUCTION

Rheumatoid Arthritis

Rheumatoid arthritis (hereinafter referred to as RA) is the most common form of inflammatory rheumatism, a chronic, autoimmune, systemic disease of unknown etiology. In addition to rheumatoid arthritis, inflammatory rheumatism can occur in several specific forms, such as psoriatic arthritis, systemic lupus erythematosus, ankylosing spondylitis, reactive arthritis as well as juvenile idiopathic arthritis (O'Brien & Backman, 2010: 112).

At the heart of this autoimmune disease is the abnormal antibody and T-cell responses to an auto-antigen causing a widespread inflammatory process in the synovial cells lining joint capsules (Haines, 2004). The main characteristic of the disease is synovitis, which symmetrically engages the peripheral joints, most commonly the small joints of the hands and feet, the wrists, elbows, shoulders, knees as well as the cervical spine. Synovitis, synovial inflammation and increased production of synovial fluid lead to swelling of the joints, redness and pain, and the prolonged duration of this condition further damages the surrounding joint structures, ligaments and tendons of the surrounding muscles. Generally, the clinical picture of RA describes pain, decreased range of mobility in the joints, muscle function and hand strength, stiffness of varying intensity, fatigue, and decreased general functionality of the person. In the end stage of the disease, the inflammatory process destroys the cartilage, there is erosion of the bones entering the joint and the appearance of characteristic disorders leading to a decrease or complete loss of function of the affected segments and extremities. The described changes occur over several months or years, alternating through the stages of exacerbation and remission (O'Brien & Backman, 2010: 212-214).

In addition to arthrogenic and bone structures, other systems and tissues of the body such as the skin, small blood vessels (vasculitis), eyes (scleritis, uveitis), fibrous changes in the subcutaneous tissue (around the elbow) can be affected by the inflammatory process. The inflammatory process can affect the heart (myocarditis, pericarditis), lungs, kidneys, and possibly peripheral neuropathies (Haines, 2004). Multisystemic impairments, longevity, and chronicity of symptoms as significant features of RA place this disease among the leading causes of disability (Song et al., 2006). Severe or untreated RA can shorten life expectancy by six to 10 years (Olejarova, 2008), which is equivalent to the effects of diabetes, stroke, or coronary heart disease.

The incidence of RA is estimated to be between 20 and 50 patients per 100,000 inhabitants in European countries (EUMUSC, 2014). Some studies indicate that more than 2.3 million people have been diagnosed with RA in Europe (Lundkvist et al., 2008). In addition to older patients, according to slightly older data of the *National Health Interview Survey,* USA, 1998) the estimated annual prevalence is 1.3% for people under 25 years of age and close to 400,000 children, adolescents, and young people suffering from arthritis in the United States (Evans & Cousins et al., 2011; Lawrence et al., 1998). The disease occurs more frequently in women than in the male population in the ratio 2:1 (Kremers & Gabriel, 2004; Symmons et al., 2002) or according to recent data 3:1 (Kaas & Tothova, 2017), but this ratio decreases with age at 1.2: 1 (Silman, 2001). The disease occurs between 35-50 years of age and the incidence increases with aging but can also occur in older people (Zlatković Švenda, 2014).

In our environment, according to the methodology and design of determining the prevalence of the European League Against Rheumatism (EULAR) and relative to the French population as a reference, it has been established that by gender and age, the standardized prevalence of RA in Serbia is 0.34 % for the total population, that is, 0.17% for men and 0.49% for women (3:1) and that it is the highest in the 65-74 age group (0.88% in the male, 1.46% in the female population). In relation to the standard population of central Serbia, by age and gender, the standardized prevalence of RA for the entire population of central Serbia over 18 years of age, is 0.35%, namely 0.16% for men and 0.51% for women. According to the geographical areas of central Serbia, the standardized prevalence of RA in Belgrade (relative to the standard population of central Serbia) is 0.30% and is lower than the standardized prevalence of RA in the southern cities of central Serbia, Čačak, Užice and Kruševac, being 0.42% (Zlatković Švenda et al., 2014).

In RA therapy, standard pharmacological therapies are used as well as rehabilitation procedures that contribute to better control of the disease but not its cure, and these patients daily face chronic pain as a major symptom of the disease. Early intervention procedures are known to significantly reduce the impact of chronic inflammation and facilitate clinical remission, although remission rates are still suboptimal and radiographic progression occurs in about half of all RA patients (Giacomelli et al., 2015).

Current strategies in the treatment of RA are based on the early diagnosis and implementation of modified antirheumatic drugs that reduce disease activity and thus directly affect the reduction of impairment and the onset of disability (Ahlstrand et al., 2011). The modern approach in the treatment of RA with biological agents and therapy has proven to be very successful in stopping the progression of the disease, however long-term use of drugs is associated with adverse side effects and consequences, including gastrointestinal problems, kidney damage, liver or cancer development (Wolfe & Michaud, 2007). The application of modern therapy with biological agents changes the up to now expected clinical picture of the disease, slows and potentially prevents the progression of the disease and thus improves the health quality of life of these patients. The question is the impact of these drugs on the daily demands and activities of the individual in relation to family, work and society.

Social Participation

The concept of participation plays an important role in the International Classification of Functioning, Disability and Health, (ICF; World Health Organization, 2001). By definition, ICF participation represents *involvement in life situations*. This definition indicates how an individual participates in society, for example, in the process of education, socializing and interacting with other people, leisure, hobbies and sports, more specifically what is the significance of these activities for the individual as well as satisfaction with time spent in an activity or participation in the *role*. The role includes, for example, the role of parents and communication within the family, the role of the employee or student, formal relationships and communication in society or of personal affinities within leisure, participation in the community, and assistance to other people (Gignac et al., 2008; McKenna et al., 2004).

Social participation is defined by the social roles of the individual. Hence not with action or task to be performed as part of the activity but rather a reflection of the capabilities, environmental conditions and personal characteristics of the individual. In this sense, when determining social participation, it is assessed whether a person can be in that role in the way he or she wants, and how important it is for the individual to participate in the role, not whether the activity which this role bears has been carried out or performed (Davis et al., 2009; Gignac et al., 2008). With this in mind, Gignac et al., suggest that when assessing social participation, one should take into account one's personal preferences as well as the importance an individual gives to it, then the manner and time a person wants to spend participating and attending the role (in a family setting, school or work).

In addition to interest in the outcomes of rehabilitation procedures and modern pharmacological therapy in the treatment of RA, prevention of further impairment and maintenance of mobility, it is necessary to take into account the impact of the disease on other aspects, such as participation, through social involvement, work, family, leisure activities. Therefore, it is necessary to clarify the significance of the impact of the disease on the psychosocial factors that, due to the chronicity of the disease, should be included in rehabilitation.

Exploring the ways in which patients with chronic arthritis understand the concept of quality of life, Melm et al., (2017) highlighted that social participation is an experience of belonging to a social context, through a qualitative study involving twenty-two patients with chronic arthritis. The patients who were interviewed experience the quality of life through participation in terms of belonging to the community, home environment, work, and the wider environment. Participation involves staying out of the house, in close surroundings and in the neighborhood interacting with other people. Respondents taking part in different activities with other people of different gender and age are part of the social context and have a sense of belonging. According to the conclusions of Melm et al., (2017) for a person whose quality of life is being assessed, one of the ways to understand it is through participation, the experience of belonging to family, colleagues, friends from whom he/she is accepted and appreciated.

In the context of participation, McCarron (2015) examined the effects of the presence of peer support on the quality of life of patients with rheumatoid arthritis. Impaired physical functioning and lack of support make social participation vulnerable and as is with patients in isolation because of their reduced ability to participate with the environment under the same circumstances in different aspects. According to McCarron's findings, RA patients have a fear of loneliness, exclusion, and inability to participate in society due to the characteristic symptoms of arthritis and restrictions. In the area of daily life, social support is needed to empower participants with increased knowledge and self-efficacy, McCarron concludes.

Characteristic symptoms of RA can also be a significant cause of reduced social participation. In addition to evident physical impairments, the clinical symptoms of RA and their long-term effects significantly affect physical health and independence. Patients with RA recognize pain as a major cause of their decreased activity and participation (Carr et al., 2003; Minnock, FitzGerald, & Bresnihan, 2003). Despite various rehabilitation procedures, pain is a chronic symptom, of medium and high intensity, which limits the patient's physical activity and participation through presence in important life aspects. Fatigue is also a disabling factor affecting the daily life and work performance of a person with RA. Fatigue is fundamentally associated with the active course of the disease and significantly affects the quality of life segments related to physical fitness, vitality and emotional life (Kaas & Tothova, 2017; Mc Cabe et al., 2013; Turan et al., 2010).

When it comes to social participation, one of the studies (Gignac et al., 2008) assessed the importance of diverse social roles in the lives of people with osteoarthritis, a form of inflammatory arthritis, the satisfaction with time spent in roles and fulfillment of those roles, as well as the share of demographic, health and psychological factors according to role perception. The sample included a total of 87 subjects with osteoarthritis, 60 females and 27 males, aged 42 to 86 (average age 65.6 years). Most subjects (62%) had osteoarthritis of the knee.

In this study, the Social Role Participation Questionnaire (SRPQ; Gignac et al., 2008) was used as the basic instrument for assessing social participation. The Questionnaire was designed for the study conducted and examined 11 social roles and one general one that covered all the previous social roles. The study focused on three dimensions of social participation: the importance of social role, satisfaction with time spent in the role, and satisfaction with fulfilling the social role e.g. participation in the community, intimate relationships, work. Other data collected were related to the demographic structure of the sample and the presence of other diseases, symptoms of osteoarthritis, presence of pain, activity limitations, and the presence of depression and/or anxiety.

The findings indicated that subjects with osteoarthritis rated multiple roles as significant or important, but with a low to moderate association with satisfaction. In addition, SRPQ dimensions related to the importance and satisfaction differed. Satisfaction with time spent in roles and satisfaction with role fulfillment were highly correlated ($r = 0.83$). Lower levels of significance or importance of roles were associated with age, lower levels of education and lower incomes, but also with greater invasiveness of the disease. Less satisfaction with time spent fulfilling the roles was found in younger subjects and was associated with greater reported pain, greater disease invasiveness, while less satisfaction with role fulfillment was associated with greater disease invasiveness and depression (Gignac et al., 2008). The authors find that when roles are rated as more important, the subjects are more likely to perceive their illness as more invasive or with a greater disruptive impact on their lives.

Ankylosing spondylitis also belongs to the group of inflammatory rheumatism, so we took Van Genderen's study into account (Van Genderen et al., 2018). The study was conducted to research the relationship between social participation and life satisfaction in people with ankylosing spondylitis and to compare the results with a control group of healthy subjects. The sample included a total of 246 subjects with spondylitis with a mean age of 51 ± 12 years, of whom 62% were male. According to the data, the disease lasted on average 17 ± 12 years. The control group consisted of 510 healthy subjects with a mean age of 42 ± 15 years, of whom 70% were male. Data were collected online and several scales were applied. For the purpose of assessing social participation, this group of authors also implemented the Social Role Participation Questionnaire (SRPQ). A version of the Questionnaire was applied that assesses four dimensions of participation (role importance, satisfaction with time spent fulfilling the role, performance satisfaction, restrictions) across 11 social roles, and through one general one that takes into account all the previous social roles. However, for analytical purposes, participation in social roles has been viewed in three domains: interpersonal relationships, leisure and work (employment). Findings showed that more subjects with spondylitis expressed dissatisfaction with life, and that fewer expressed extreme satisfaction compared with the control group of healthy subjects. In both groups, the connectedness of participation in social roles with greater life satisfaction was calculated, with correlations higher among subjects with ankylosing spondylitis. Within the domains of participation, regression analysis showed that interpersonal relationships made the largest contribution regarding the life satisfaction scores in subjects with spondylitis. It is also interesting to note that satisfaction related to role fulfillment and time spent at work were related to life satisfaction independently of other domains of participation in the control group of healthy subjects, but that none of the dimensions that characterize job participation had an independent share in explaining life satisfaction with employed subjects with ankylosing spondylitis. By changing life priorities and re-evaluating life satisfaction in situations of coping with chronic illness, income becomes less important than social roles (Van Genderen et al., 2018).

We conclude that the findings emphasize the importance of supporting people with spondylitis to improve their participation in social roles, especially in areas such as close, interpersonal relationships and leisure activities, which are usually neglected when working with people with ankylosing spondylitis. A basic recommendation would be for healthcare professionals to take social roles into consideration when discussing care and treatment plans with their patients from the population with inflammatory rheumatism.

Aim of the Research

The aim of the research was to point out the characteristics of certain aspects of social participation of persons with rheumatoid arthritis, by determining the importance of participation in diverse roles and the effects of restrictions in role participation, by comparing the group of subjects with rheumatoid arthritis with the group of subjects from the general population.

METHOD

Sample

The study sample consisted of 65 subjects, including 28 subjects with rheumatoid arthritis and 37 subjects from the control group. The study groups did not differ in gender, age, place of residence, educational, work, family and marital status and in the degree of physical activity. The sample of subjects with rheumatoid arthritis consists of persons undergoing rehabilitation at the Institute for Rheumatology in Belgrade, a health institution that deals with the treatment and rehabilitation of rheumatic diseases. Upon obtaining approval from the institution's Ethics Committee, by insight into the database and medical documentation of the institution selected, the sample included patients with different duration of the disease and disease activity. The control group consisted of subjects from the general population who did not suffer from musculoskeletal diseases.

When forming a sample of subjects with rheumatoid arthritis, the criteria for exclusion from the sample were patients with cancer, NYHA Class III and Class IV heart failure, complicated and inadequately treated patients with diagnoses of glandular disease, other inflammatory rheumatic diseases.

Table 1 shows the structure of the examined groups with respect to gender.

Table 1. *Structure of the examined groups in relation to gender*

Group	**Male**		**Female**		**Total**	
	N	%	N	%	N	%
RA	4	14.3	24	85.7	28	100
K	14	37.8	23	62.2	37	100

χ^2 (1. n = 65) = 3.32, p = 0.07, *fi* = -0.26

Table 1 shows that there were 47 female and 18 male subjects in the sample. In the RA group, women were more frequently represented, being 24 of them (85.7%), as well as in the control group, 23 of them (62.2%), compared to the male subjects in the RA 4 group (14.3%) and control group 14 (37.8%).

The Chi-Square of Independence, with Yates's correction for continuity, did not show a statistically significant difference between the studied groups in relation to: gender (χ^2 (1. n = 65) = 3.32, p = 0.07, *fi* = -0.26), place of residence (χ^2 (1. n = 65) = 0.54, p = 0.46, *fi* = 0.12), family status (χ^2 (1. n = 65) = 1.63, p = 0.20, *fi* = -0.19) and exercising physical activity (χ^2 (1. n = 65) = 0.46, p = 0.79, *fi* = 0.08).

The independent samples t-test revealed that there was no statistically significant difference in age between subjects with RA (M = 57.43, SD = 11.35) and subjects from the control group (M = 61.05, SD = 10.95); t (65) = -1.30, p = 0.20, education between RA subjects (M = 3.29, SD = 0.71)) and subjects from the control group (M = 3.27, SD = 1.07); t (65) = 0.07, p = 0.95, work status between subjects with RA (M = 2.64, SD = 1.50)) and subjects from the control group (M = 2.68, SD = 1.51); t (65) = -0.09, p = 0.93, as well as in marital status between subjects with RA (M = 2.04, SD = 1.60) and subjects from the control group (M = 2.54, SD = 1.86); t (65) = -1.15, p = 0.25.

Instruments and Method of Data Collection

Data regarding gender (male, female), age, place of residence (urban, rural area), educational level (incomplete elementary school, elementary school, secondary education, higher education, university degree), work status (employed, unemployed, householder, retired, early retirement), marital status (married, common law marriage) and family status (in the community, independently), as well as physical activities (active, inactive, occasional) of the subjects were collected using a specially constructed questionnaire for the needs of this research.

The Importance of Participation in Diverse Roles and Restrictions in Role Participation Subscales within the Modified Social Role Participation Questionnaire (Modified 2011, SRPQ) (Gignac et al., 2011) were used for determining the importance of participation in diverse social roles and the effects of restrictions in participation in diverse social roles. The authors of the original version of the SRPQ instrument are Gignac et al., (2008), and we used a modified version of the same author (Gignac, Backman, Badley, Davis, & Lacaille, 2011), (personal correspondence). The original version of the Questionnaire consisted of eleven social role domains and one global question, composed on the basis of pilot researches, psychosocial social role research, existing instruments, arthritis studies (Backman, 2006; Carr & Thompson, 1999; Gignac et al., 2000; Hewlett et al., 2001; Tugwell et al., 1987, according to Gignac et al., 2008).

The 2008 version of the SRPQ Questionnaire assessed the following three dimensions of social participation: the importance of social role, satisfaction with time spent in the role, and satisfaction with performance in social roles. More specifically, the following roles are covered: (1) in the community, religious and cultural events; (2) social events; (3) leisure; (4) hobbies; (5) informal contacts and socializing; (6) travel or vacation; (7) business; (8) education and training; (9) close and intimate relationships; (10) relationships with children/grandchildren; (11) family relationships; and (12) a global assessment of participation in social roles, i.e. in all aspects of the subjects' lives. In the literature, we find more research in which the SRPQ instrument, of different versions, (Davis et al., 2011; Gignac et al., 2013; Oude Vosher et al., 2016; Van Genderen et al., 2016; Van Genderen et al., 2017) has been used to evaluate social participation.

The objective of applying the 2011 Modified SRPQ is the assessment of an individual's perception of: 1) the importance of participation in diverse social roles, 2) the restrictions in role participation, and 3) the satisfaction with participation in social roles. The Questionnaire evaluates twelve (already described) domains. The questions are designed to help individuals reflect on their health in general or on specific conditions (e.g. knee pain associated with arthritis). Among other things, the respondents were asked whether they were currently employed, whether they were attending school, whether they were in an intimate relationship, or had children or grandchildren. The Questionnaire can be used when the sample is made up of healthy people or patients with some form of inflammatory rheumatism (osteoarthritis, ankylosing spondylitis). In our research we applied the Modified SRPQ in subjects with rheumatoid arthritis and in the general population as a control group. The assessment included two dimensions of participation in social roles, through two subscales. The significance or importance of participation in diverse roles subscale included questions under a.) and the limitations or restrictions or role participation included questions under b.) through eleven social roles domains and the twelfth which related generally to all aspects of life. The respondents were asked in the last item to take into account all the social roles previously examined. Each role in each dimension was rated on a Likert scale from 1- not at all important/no difficulty, 2- a little/some difficulty, 3-somewhat/a lot of difficulty, 4-very/unable to do, 5-extremely important/not applicable.

In order for the Modified SRPQ to be applied in our study, this instrument was translated from English into Serbian using the "double-blind translation" i.e. the Modified SRPQ (2011) version of the instrument was translated into Serbian and then the Serbian version of the translation by another person, was again translated into English. The assessment was conducted by the interviewer conducting the interview and completing the data, or the respondent completed the questionnaire him/herself. It took 10 to 15 minutes to complete the Questionnaire.

Cronbach's coefficient of reliability was used to determine the reliability of the instrument. The Importance of Participation in Diverse Roles Subscale in our study had satisfactory internal consistency (Cronbach's alpha coefficient was 0.71), and the Restrictions in Role Participation Subscale had good internal consistency (Cronbach's alpha coefficient was 0.86).

Statistical Data Processing

Data processing was performed using the Statistical Package for the Social Sciences (SPSS statistics 20.0). In the analysis and processing of the obtained data, in addition to descriptive statistics and Cronbach's alpha coefficient to determine the internal consistency of the subscales used, we used the following statistical techniques: the Chi-Square of Independence, independent samples t-test, Mann-Whitney U test and Pearson's correlation coefficient. The results are presented in tables.

RESULTS

Table 2 shows the achievements of the examined groups in the Importance of Participation in Diverse Roles and Restrictions in Role Participation Subscales within the Modified SRPQ, expressed through mean values and standard deviations.

Table 2. *Achievements of the Subjects with RA and Subjects from the Control Group in the Importance of Participation in Diverse Roles and Restrictions in Role Participation Subscales within the Modified SRPQ*

Modified SRPQ Roles	**Importance of Participation in Diverse Roles**		**Restrictions in Role Participation**	
	RA (M ± SD)	**K (M ± SD)**	**RA (M ± SD)**	**K (M ± SD)**
Physical leisure	3.61 ± 0.96	3.54 ± 1.22	2.43 ± 0.96	2.19 ± 0.74
Hobbies	3.46 ± 1.07	3.84 ± 0.99	2.43 ± 0.88	1.68 ± 0.67
Community, cultural events	3.50 ± 1.14	3.00 ± 1.33	2.14 ± 0.76	1.51 ± 0.65
Social events	3.96 ± 1.26	4.19 ± 0.91	2.29 ± 0.81	1.54 ± 0.69
Casual contact	3.71 ± 1.18	4.27 ± 0.43	1.96 ± 0.84	1.08 ± 0.28
Travel, vacation	4.18 ± 0.91	4.08 ± 1.09	2.32 ± 0.95	1.70 ± 0.78
Paid job	3.86 ± 1.46	3.38 ± 1.69	1.57 ± 0.50	1.57 ± 0.50
Education	1.89 ± 1.29	2.05 ± 1.27	1.89 ± 0.31	1.92 ± 0.28
Close relationship	3.82 ± 1.28	3.54 ± 1.52	1.36 ± 0.56	1.51 ± 0.69
Relationship with children	4.46 ± 0.88	4.84 ± 0.44	1.29 ± 0.81	1.08 ± 0.49
Family relationship	4.86 ± 0.65	4.89 ± 0.39	2.11 ± 0.96	1.70 ± 0.66
All aspects of life	4.18 ± 0.77	4.22 ± 0.89	2.39 ± 0.74	1.89 ± 0.62
Total	45.50 ± 7.12	45.84 ± 6.09	24.18 ± 5.89	19.42 ± 4.17

Table 3 shows the results of examining the differences between the RA and the general population in the Importance of Participation in Diverse Roles Subscale. Man-Whitney's U test was used to test for differences.

Table 3. *Differences between the Examined Groups in the Importance of Participation in Diverse Role Subscale*

Modified SRPQ Roles	**Importance of Participation in Diverse Roles**		
	U	**z**	**P**
Physical leisure	497.00	- 0.29	0.772
Hobbies	409.00	- 1.51	0.130
Community, cultural events	405.00	- 1.53	0.124
Social events	412.50	- 0.36	0.717
Casual contact	380.50	- 1.94	0.052
Travel, vacation	507.50	- 0.15	0.882
Paid job	443.50	- 1.05	0.245
Education	477.00	- 0.60	0.549
Close relationship	481.00	- 0.51	0.609
Relationship with children	399.50	- 2.14	**0.033**
Family relationship	485.50	- 0.72	0.473
All aspects of life	489.00	- 0.41	0.680
Total	498.50	- 0.26	0.796

The results presented in Table 3 show that there are no statistically significant differences in the perception of the importance of exercising and exercising diverse social roles between persons with rheumatoid arthritis and persons from the general population, except in the domain of relations with children/offspring, where the importance of these relationships is lower in persons with rheumatoid arthritis compared to persons from the general population.

Table 4 shows the results of examining differences between the RA and the general population on the Restrictions in Role Participation Subscale. Mann-Whitney's U test was used to test for differences.

Table 4. *Differences between the Examined Groups in the Restrictions in Role Participation Subscale*

Modified SRPQ Roles	**Restrictions in Role Participation**		
	U	**z**	**P**
Physical leisure	445.00	- 1.09	0.274
Hobbies	273.00	- 3.45	**0.001**
Community, cultural events	288.00	- 3.28	**0.001**
Social events	255.50	-3.74	**0.000**
Casual contact	213.50	-4.89	**0.000**
Travel, vacation	327.50	-2.67	**0.007**
Paid job	516.00	-0.03	0.975
Education	504.50	- 0.36	0.721
Close relationship	464.00	- 0.84	0.400
Relationship with children	459.00	-1.69	0.091
Family relationship	395.00	-1.76	0.079
All aspects of life	326.00	-2.76	**0.006**
Total	264.50	-3.25	**0.001**

The results presented in Table 4 indicate the presence of statistically significant differences between subjects with RA and those from the general population. Namely, the importance of restrictions in role participation is statistically significantly more pronounced in the group of subjects with rheumatoid arthritis in domains of hobbies, in community activities, social events, travel and vacations, daily contacts, but also in overall community activities. Finally, on the subscale as a whole, there is a statistically significant difference to the detriment of subjects with RA. In other words, restrictions significantly limit the social participation of people with rheumatoid arthritis.

Table 5 shows the results of establishing the links between certain demographic variables and the self-perception of participation in diverse roles of persons with rheumatoid arthritis. Pearson's correlation coefficient was used to determine the association.

Table 5. *Association between demographic variables and achievements of respondents with RA in the Importance of Participation in Diverse Roles and the Restrictions in Role Participation Subscales within the SRPQ*

	Importance of Participation in Diverse Roles	**Restrictions in Role Participation**
Gender	0.088	0.048
Age	- 0.132	0.315
Place of residence	- 0.102	- 0.020
Education	0.292	- 0.251
Employment status	- 0.007	**0.554****
Family status	- 0.120	0.064
Marital status	- 0.099	0.064
Physical activity	- 0.346	0.310

Regarding the results of the association between demographic variables and participation of diverse roles of persons with rheumatoid arthritis shown in Table 5, it can be seen that restrictions related to increased unemployment, i.e. decreased work engagement are more frequently present, while other variables are not associated with the respondents' achievements on the Importance of Participation in Diverse Roles and the Restrictions in Role Participation subscales.

DISCUSSION

The aim of the research was to point out the characteristics of certain aspects of social participation of persons with rheumatoid arthritis, by determining the importance of participation in diverse roles and the effects of restrictions in role participation, comparing the group of subjects with rheumatoid arthritis with the group of subjects from the general population. The results obtained in this study show that there are no statistically significant differences in the perception of the importance of participation in diverse roles between persons with rheumatoid arthritis and persons from the general population, except in the domain of offspring relationships, where the importance of these relationships is lower in persons with rheumatoid arthritis to persons from the general population. The results in the referred subscales are different from the results obtained by the research conducted by Genderen et al., (2016) where one of the versions of the SRPQ Questionnaire was used as an assessment tool.

In that study, unlike RA patients, people with ankylosing spondylitis, which belongs to the group of inflammatory rheumatism, gave greater importance of participation in diverse roles compared to the control group, which contradicts the hypothesis set by the author. In contrast, in the findings of Gignac and the author (2013), the assessment of the importance of participation in diverse roles of patients with osteoarthritis which included 177 middle-aged and elderly subjects (≥ 40) compared to the control group is without statistically significant differences, which is consistent with our results (Gignac et al., 2013, according to Genderen et al., 2016). It is certainly important to bear in mind here that there are specificities in the clinical picture of RA in relation to other forms of arthritis (O'Brien & Backman, 2010: 112-113), however, the accompanying symptoms, limited mobility and functionality in daily activities as well as the possibility of participation in family and social roles represent an important and common outcome for patients with some form of arthritis (Alliance for the Canadian Arthritis Program, 2005, according to Davis et al., 2009).

According to our results, the existence of restrictions in role participation is statistically significantly more pronounced in the group of rheumatoid arthritis subjects in domains of hobbies, in community activities, social events, travel and vacations, daily contacts, but also in overall community activities. Thus, restrictions significantly limit the social participation of persons with rheumatoid arthritis. And in the studies mentioned above (Genderen et al., 2016; Gignac et al., 2013), we find that the group of arthritis patients has significantly more restrictions in roles related to leisure, work, and travel and vacation activities. We associate this state of affairs with the clinical picture of RA that we already know: pain, decreased range of mobility in the joints, decreased muscle strength and hand strength, stiffness of varying intensity, fatigue and decreased general functionality of the person. Thus, the findings of Benka and Nagyova's study (2016) indicate an association between social participation, characteristic symptoms of RA (pain, fatigue, functional limitations), psychosocial variables, and personal resources. The study found significant limitations in the area of social participation, as well as that patients with greater restrictions in social participation reported more symptoms of pain, fatigue and impaired functionality, higher levels of anxiety and depression, regardless of whether in the earlier stage of the disease or with confirmed chronic arthritis. There may not have been a significant difference in the duration of the disease, since patients with a disease duration of up to four years already met the criteria for the early RA group, and in some way they had already adjusted to their condition.

According to Kaas and Tothova (2017), the most common and persistent symptom of pain occurs in nearly 98.5% of RA patients tested with the pain having varying intensity and frequency. The aforementioned researchers examined the quality of life of persons with RA within six domains (physical and mental health, level of independence, social relations, environment and spirituality) as well as the overall quality of life in relation to the general population of the Czech Republic The results of the research showed that the differences in the areas related to experience, social relations, environment and spirituality are statistically significant, but to a lesser extent compared to significantly worse quality of life in the domains of physical health (98.5% as a reason for pain, 94% of fatigue) and the level of independence. The obtained findings are at odds with some of the studies cited by Kaas and Tothova, which highlight the numerous problems that the symptoms of pain, fatigue, and others cause within family participation, married life, and social relationships (Broome & Llewelyn, 1995; Chung et al., 2016; Hari, 2015). The lower statistical significance in the social domain should certainly not be neglected when planning rehabilitation, as some aspects of the mentioned areas were evaluated very negatively. The qualitative research design and the individual approach certainly reveal in more detail in which domains of quality of life these patients have problems and whether they are solely due to the disease itself or due to other circumstances, since healthy people also face physical and social restrictions (Kaas & Tothova, 2017).

Regarding the association between demographic variables and the participation in diverse roles of persons with rheumatoid arthritis, the presence of restrictions related to increased unemployment, i.e. decreased work engagement, was shown to be more frequent, while other variables were not associated with the achievement of the respondents in the Importance of Participation in Diverse Roles and the Restriction in Role Participation subscales. The chronicity of typical arthritis symptoms, functional limitations caused by the inflammatory process, limited mobility and deformities can be a cause of physical disability and have an impact on loss of job, income, or change in family status (Giacomelli et al., 2015; Van Jaarsvel et al., 1998).

A group of Dutch researchers (Van Jaarsvel et al., 1998) found a negative impact of RA on work ability and social participation in the first years of illness, more accurately according to their results in the first six years of symptom recording. The cross-sectional study involved 363 patients with a disease duration of SD of 2.8 years. It was found that in the group of men aged 45-64, there were 63% of unemployed compared to 32% according to the general data ($p < 0.01$), while in the female patients in the same age group 76% were unemployed compared to 67% according to the general data ($p < 0.05$). 59% of employed patients reported to have had problems at work due to RA while the number of hours in a work week is reduced. 41% of the unemployed patients believe it is a consequence related to RA.

Activities related to unpaid and home-based, day-to-day chores have also been reduced. People with RA have difficulties in the workplace due to the daily pain in various segments, especially the hands, they become fatigued quickly, they are endangered by physically demanding working conditions and an unsuitable environment. The discrepancy between work requirements and the ability of an employee with chronic health problems results in reduced self-efficacy and absenteeism. According to some data, RA employees are absent for 40 days per year compared to the average 6.5 days of sick leave (National Audit Office, London, 2009), which implies reduced productivity, and the impact of this chronic illness is not only reflected in the high cost to the individual and the employer but also the society. Ongoing health problems in relation to work requirements threaten the employee's status, hence one-third of RA employees leave work within three years of diagnosis and as much as 50% within ten years (Hammond et al., 2017).

CONCLUSION

Based on the results of the research, it can be concluded that persons with RA do not differ greatly from those of the general population when it comes to the perception of the importance of participation in diverse roles in the social context in which they exist, which is largely in line with the findings of other researchers. However, the restrictions characteristic for RA significantly limit the social participation of these persons. The findings of this research may be of use to practitioners in working directly with people with RA in the rehabilitation process. On the other hand, these findings could serve as a starting point for future studies focusing on the issue of social participation of persons with RA.

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USING OF INERTIAL MEASUREMENT UNIT (IMU) IN MOVEMENT ANALYSIS IN PERSONS WITH PARKINSON'S DISEASE

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SUMMARY

Parkinson's disease (PD) is a second commonest neurodegenerative disorder, followed by the presence of motor symptoms that affect the functioning of a person in the community. Technology development and implementation of various diagnostic and assessment procedures can improve the rehabilitation process of this population. IMU sensors have the potential to identify and provide valuable information about motor performances and behavior, as well as the quality of movements. The aim of this paper is to present the possibilities of using Inertial Measurement Units sensors in movement analysis in persons with Parkinson's disease. Analyzed papers were selected by researching electronic databases: PubMed/MEDLINE, Science Direct, Scindeks, and Google Scholar and published between 2014 and 2020. The analyzed researches have shown that the IMU can be used in the evaluation of motion range and amplitude, repetitive finger taping parameters, characteristics of movements and activities important for everyday living, gait characteristics and parameters, as well as PD related symptoms, such as bradykinesia, tremor, festination, freezing of gait. Sensors, consisted in IMU, also can be fused together to provide a 3D picture of human motion.

Key words: accelerometer, gait, gyroscope, magnetometer, motor behavior, motor performances

INTRODUCTION

Parkinson's disease (PD) is a complex, chronic and long-term neurodegenerative disorder, which progressively deteriorates the motor functions of the individual, and characterized by the appearance of motor symptoms such as bradykinesia, dyskinesia, tremor, and rigidity, usually between 50 and 70 years of age (Aghanavesi et al., 2020; Nguyen et al., 2018). It is predicted that by the 2020, about 3% of the world population above 65 years of age is likely to be affected (Palakurthi & Burugupally, 2019). The disease is named after the London physician James Parkinson, in 1817, identified the basic characteristics of the disease, in his monography An Essay on Shaking Palsy (Kostić, 2009). James Parkinson's famous essay was published towards the end of his career, and presumably it must have taken him a long time to collect the six cases he presented; at this time neurology was a descriptive subject, and this is why Parkinson characterised the cases, even from a distance, but did not examine patients in detail (Hindle, 2008, p. 5). Besides the motor symptomatology, PD is characterized by some non-motor symptoms such as hyposmia, rapid eye movements, sleep behavior disorder, cognitive disorders, personality changes, pain, paresthesias, and depression (Baker &

Gershanik, 2006). The disease progresses over time, as well as the severity and quality of the symptoms, increasing the chance of severe complications (Caramia et al., 2018).

Many experts and persons demand to know more information on their current position and movements to work better and more efficient (Ahmad et al., 2013). Individual characteristics in motor function profile, different stages of the disease, presence of the accompanying problems and difficulties which impair the everyday functioning of an individual with PD, as well as a technology improvement, are just some of reasons for the implementation of different tools and systems for assessment of motor functions and biomechanical characteristic of the individual. For an understanding of pato-physiological phenomena, by quantitative assessment, it is necessary to collect accurate and unbiased results (Pasluosta, Gassner, Winkler, Klucken & Eskofier, 2015). Ideal technological platforms must be simple to use, applicable for everyday clinical practice, and preferably low-cost (Caramia et al., 2018). Inertial Measurement Unit (IMU) sensors, are used widely in many different movable applications (Ahmad et al., 2013), and cost-effective. These sensors often include accelerometers, gyroscopes and magnetometers, allowing the derivation of movement of various body segments (Witchel et al., 2018). Nguyen et al., (2018), points that the wearable sensors, such as inertial measurement units, have been widely used to measure the quantity of physical activities during daily living in healthy and individuals with movement disorders. Monitoring of PD patients, with inertia sensors, is a relevant method for a better assessment of symptoms and their quantification based on motion data (Piro et al., 2016). In population with movement disorders, such is PD, IMU sensors have potential to identify and provide valuable information about quality of movement (Nguyen et al., 2018), leg agility, pronation-supination movement of hands, walking (Aghanavesi et al., 2020), finger movement, taping durations, rhythm, fingers open and close speed, tapping angle, as well as patient's motor performance (Đurić-Jovičić et al., 2018).

Based on theoretical assumptions, by collecting and analyzing the literature research articles, the aim of this paper is to present the possibilities of using Inertial Measurement Units sensors in movement analysis in persons with Parkinson's disease.

Parkinson's disease

PD is a common adult-onset neurodegenerative disorder, whose disabling signs are engendered by the loss of specific subsets of neurons, including dopaminergic neurons in the substantia nigra (Przedborski, 2015), and second neurodegenerative commonest disorder (Meara & Hobson, 2008), diagnosed based on motor impairment (Knežević et al., 2019). PD is a universal disorder, with a crude incidence rate of 4.5–19 per 100 000 population per year, and it has been recognized that a small proportion of persons develop the disease at an early age (Baker & Gershanik, 2008). The aforementioned authors also emphasize that a patients with the disease before 40 years of age are generally designated as having "early-onset" PD. Among them, those beginning between 21 and 40 years are called "young-onset" PD, while those beginning before the age of 20 years are called "juvenile Parkinsonism". Approximate 5% of patients are diagnosed before the age of 40 years (Knežević et al., 2019).

Substantia nigra is an elongated nucleus in the midbrain, made of two parts: pars reticulata and pars compacta, which consist of pigmented neurons that use dopamine as a transmitter (Kostić, 2009). One of the most important roles of the substantia nigra pars compacta is reflected in motor control and signal transmission to the cerebral cortex responsible for initiating motor activity. According to the previously mentioned facts, it can be concluded that the neuron deficiency in this part of substantia nigra has a great impact on motion, therefore the motor activity of every person. Primary damage in PD is progressive degeneration and extinction of dopaminergic neurons in pars compacta substantia nigra (Kostić, 2009). Although, the pathogenesis of PD is not completely explained, by identification and sharing information about PD, contributes to solving the mystery associated with the causative agents (Table 1) (Goldman and Tanner, 2015).

A considerable number of problems associated with motoric functioning, that lead to difficulties in performing activities of daily living, are the main characteristic of PD. The symptoms of PD are predominantly motor-based such as tremor, rigidity, bradykinesia, postural instability, hypomimia, micrographia, festination, shuffling gait, dysarthria, and dystonia (Palakurthi & Burugupally, 2019). Kostić (2009) emphasizes that the primary cause of functional disability is caused by bradykinesia, which includes a lack of spontaneous motoric, difficulties in movement initiation, slow movement performance, with decreasing amplitude, and losses of rhythm in performance of motor activities. In addition to bradykinesia, PD is characterized by the appearance of rigidity (increased muscle tone). Because of the existence of this problem, persons with PD take a specific body position with semiflexion in the trunk, legs (in knees), and hands (in elbows). As a consequence of an absence of resistance during movement performance, it is characteristic of the emergence of "cogwheel phenomenon". In later stages of the disease, dyskinesia, and fluctuation in motor response occurs as a result of a decrease in levodopa concentration. In addition to bradykinesia, PD is characterized by the appearance of static tremor, which is initially intermittent, asymmetrical, and most commonly occurs on one arm. Tremor can affect several parts of the body, most commonly the extremities, with characteristic alternating opposition of the thumb and other fingers, which is reminiscent of movements of "pills-rolling" (Kostić, 2009; Zach, Dirkx, Bloem, & Helmich, 2015). The stance is also disturbed in persons with PD. Decreased stability during both static and dynamic motor tasks and the risk of falling represents a serious and disabling issue that affects daily life and personal autonomy (Santamato et al., 2015). Gait is difficult, unstable, and decreased speed, with the characteristic appearance of "festinating" and "magnetic" gait.

Table 1. *Factors associated with increased and decreased risk for PD (Source Goldman & Tanner, 2015, p. 107-108)*

Factors for increased risk		Factors for decreased risk
Demographic factors Increasing age Male gender White race Family history of PD Lifestyle Head trauma Diet (dietary products, animal fats) Biometric and comorbid conditions Lower blood cholesterol Lower serum uric acid	Oophorectomy Environmental exposures Pesticides Industrial agents Solvents Metals Rural residence Drinking well water Farming Pulp mills Occupations (health care, teaching, woodworking, religious work)	Cigarette smoking and tobacco use Coffee and tea drinking History of gout Diet “Mediterrenean” diet Polyunsaturated fats Uricogenic diet High physical activity Medications Calcium channel blockers Nonsteroidal anti-inflammatory drugs Statins

Mirleman et al., (2019) described three stages of PD, with characteristic motor symptoms:

1) *Early stage*, which is characterized by, reduced arm swing and step length, decreased left arm swing, arm swing asymmetry, reduced axial rotation, slower gait speed, and postural changes.
2) *Mild to moderate PD stage*, which is characterized by, bilateral arm swing reduction, reduced step length, bradykinesia, reduced postural control and stability, shuffling steps, stopped posture and increased cadence.
3) *Advanced PD stage,* which is characterized by, reduced step length, bradykinesia, reduced postural control and stability, defragmentation of turns, reduced walking capacity, freezing of gait during turns and dual tasks or gait initiation, and severe postural changes and postural control.

Inertial measurement units (IMU) sensors application in movement assessment

Movement, motor behavior, and biomechanical characteristics of the individual for different reasons, were an area of interest between different scientists. Specifically, motor activity is important for the functioning of the individual in the community, the realization of everyday activities, but also the planning of a rehabilitation plan and program due to the presence of various conditions and diseases. In the course of biomechanical analysis, for the purpose of the accuracy of data, it is necessary to follow a certain procedure, namely: to determine the movement that is the subject of analysis, to enter all details related to the analysis of the technique in the software for kinematic analysis and to make an adequate record of all participants and the execution of the technique within the realization of assessment (Bubanj, Bubanj, Stanković, & Đorđević, 2010).

IMU sensors are used widely in motion measurement (Zhao & Wang, 2012), as well as in many different movable applications (Ahmad et al., 2013). Caramia et al., (2018), by analyzing the literature explain that IMU sensors were originally introduced in the field aerospace engineering, as means to attitude of flying objects, and to help guidance in navigation system. IMUs can be roughly divided into two groups: IMU made from two sensors type (accelerometer and gyroscope) and IMU newer generation, made from three sensors type (accelerometer, gyroscope and magnetometer) (Figure 1). Both sensors typically have three degree of freedom to measure from three axis (Ahmad et al., 2013) (x, y and z axis). The role of sensors is reflected in the tracking of movement and bio-feedback. Aceelometers are used to measure inertial acceleration, while gyroscopes are used for measuring angular velocity and rotation angle. Magnetometers are used to measure the bearing magnetic direction, as well as angle rotation, thus it can improve the reading of gyroscope (Ahmad et al., 2013). An IMU provides four to nine degrees of freedom, which refers to the type of used sensors and movement, that person performs in a 3D plane. According to mentioned, IMU with two types of sensors has in total between four and six degrees of freedom, while IMU with three types of sensors has nine degrees of freedom in total. The degree of freedom determines the number of independent parameters in the system (Ahmad et al., 2013). All signals can be sent to the host computer form each sensor, usually via Bluetooth connection, or saved on SD card.

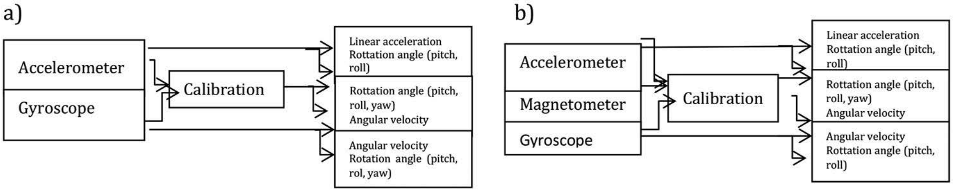

Figure 1. IMU sensors types
(a) two types of sensors b) three types of sensors) (Ahmad et al., 2013)

With the availability of new-generation miniaturized wearable IMU sensors, there is a growing opportunity for functional assessment of motor skills in various disciplines and fields, such as medicine, sports, and ergonomics (Fusca et al., 2018). In clinical practice, IMU sensors have begun to be applied for the purpose of motion analysis (Caramia et al., 2018) and objective assessment of movement patterns during the implementation of functional activities (Al-Amri et al., 2018), namely speed of execution, acceleration, orientation and angular velocities in joints (Ahmad et al., 2013) and other characteristics. The application of these sensors provides objective and sensitive indicators of movement disability, which may indicate the occurrence of different risks in various conditions (Witchel et al., 2018). In order for motion and motor activity assessment, all sensors must be placed on a body segment, whose characteristics will be assessed.

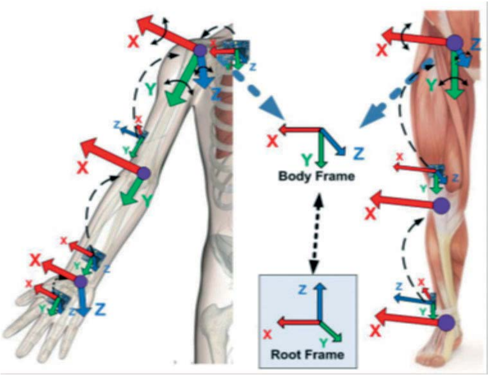

Figure 2. IMU position on arm and leg
(Chen, 2013, p. 22)

IMU system could be useful for experts, patients, and for clinicians to support their decisions, as long as it is: a user friendly system, suitable to be used outdoors in real life, and not only in the laboratory, capable for monitoring subject in natural conditions, without altering the natural and normal execution of movements and activities, and without collaboration process (Fusca et al., 2018). The aforementioned group of authors emphasizes that a system could objectively, qualitatively and quantitatively measure the movements and gait of patients with neurologic and orthopedic impairments that affect motor control.

METHOD

All collected and analysed scientific data had to be in accordance with the theoretical framework and aim of this article. Analyzed papers were selected by researching electronic databases: PubMed/MEDLINE, Science Direct, SCIndex and Google Scholar. For this purpose the method of selection was used. In order to cover bibliography more precisely, the criteria set for the purposes of the search were: research papers published in their entirety based on use of IMU system in kinematic assessment of persons with Parkinson's disease. All research papers must be published between year 2014 and 2020. The following key words were used to search for the papers: inertial measurement units (IMU), Parkinson's disease (PD), accelerometer, gyroscope, magnetometer, 3D motion tracking, motion, motor performance, movement, mobility, biomechanical, kinematic. The applied methods for the selection and analysing the articles included: the selection method, the description method, the systematization method, the analysis method, the synthesis method, and the comparison method.

RESULTS WITH DISCUSSION

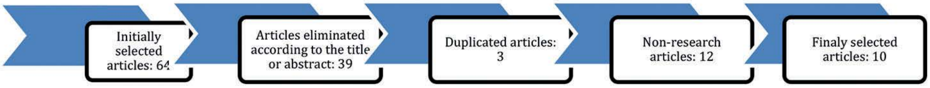

Figure 3. Data collection process

Figure 3 presents the process of collecting data from research articles. Following the aim and the set criteria of this article, ten articles were selected, and all indicated to the use of IMU sensors in the assessment of motion and motor characteristics in persons with PD (Table 2).

Table 2. *An overview of the collected and analyzed research studies*

First author (year)	Aim	Sample characteristics			Method and assessed elements	Conclusion
		N	Age	Gend.		
Aghanavesi (2020)	Compare Treatment Response Index from Multiple Sensors (TRIMS) to sensor indexes derived from individual motor tasks in persons with PD.	19	71.4 (6.3)	14 M 5 F	Two type IMU (three axial accelerometer and three axial gyroscope). The evaluation of multiple and connected measurements of motor tests (leg agility, pronation-supination movements of hands and walking) in PD based on data collected by multiple motion sensors.	Using the fusion of upper- and lower-limbs sensor data to construct TRIMS provided accurate PD motor states estimation and responsive to treatment. In addition, quantification of upper-limb sensor data during walking test provided strong results. TRIMS was highly correlated to dyskinesia (R = 0.85), bradykinesia (R=0.84) and gait (R=0.79).
Azevedo Coste (2014)	Adapt and extend freezing of gait (FOG) detectors in order to include other associated gait pattern changes, like festination, with assessment based on a inertial sensors use placed on lower limbs.	4	73 +/-3	4 M	Three type IMU. Evaluation of walk along 10 meters corridor with several proposed dual tasks.	Existing frequency-based freezing detectors are not sufficient to detect all FOG and festination episodes and the observation of some gait parameters such as stride length and cadence are valuable inputs to anticipate the occurrence of upcoming FOG.
Caramia (2018)	Identify which of the gait features are able to better distinguish the presence of PD from age matched healthy subjects.	50 (25 PD/ 25 HS)	43-88 41-79	13 M 12 F 13 M 12 F	Three type IMUs, placed on the lower and upper limbs. Participants included into a set of 6 different machine learning (ML) techniques, processing 18 different configurations of gait parameters (range of motion, spatiotemporal parameters) taken from 8 IMU sensors.	The ability of IMU-based gait analysis to discriminate patients with PD at different severity stages from age-matched healthy individuals has been shown in this study to relevantly depend on the number and location of sensors used to extract the parameters. Best results were obtained with the knee range of motion, calculated with 4 IMUs, placed bilaterally.
Dai (2015)	Introduce a wearable bradykinesia assessment system, whose core component is composed of an inertial measurement unit.	15 (8 PD/ 7 HS)	72.8 ± 10.0/ 57. 1 ± 21. 1	-	Two type IMU The grasping ranges are the three-dimensional peak-to-peak values, which are calculated separately, during grasping cycles of a bradykinesia task.	System has greater correlation with the evaluations by neurologists than other parkinsonian bradykinesia assessment systems. The modified mean range was verified as the major bradykinesia parameter (key indicator).

First author (year)	Aim	Sample characteristics			Method and assessed elements	Conclusion
		N	Age	Gend.		
Đurić-Jovičić (2016)	Investigate repetitive finger tapping patterns in patients with Parkinson's disease (PD), progressive supranuclear palsy–Richardson syndrome (PSP-R), or multiple system atrophy of parkinsonian type (MSA-P).	56 (13 PD 15 PSP-R 14 MSA-P 14 HS)	60.9 ± 9.9 65.8 ± 8.7 58.0 ± 4.5 56.8 ± 9.0		The system included two inertial measurement sensor units, miniature sensors positioned on the thumb and index finger, providing spatiotemporal and kinematic parameters.	The main finding was the lack or only minimal progressive reduction in amplitude during the finger tapping in PSP-R patients, similar to HC, but significantly different from the sequence effect (progressive decrement) in both PD and MSA-P patients. The mean negative amplitude slope of -0.12°/cycle revealed less progression of amplitude decrement even in comparison to HC (-0.21°/cycle, p = 0.032), and particularly from PD (-0.56°/cycle, p = 0.001), and MSA-P patients (-1.48°/cycle, p = 0.003). No significant differences were found in the average finger separation amplitudes between PD, PSP-R and MSA-P patients.
Lonin (2018)	Investigate how to efficiently collect wearable sensor data for the detection of bradykinesia and tremor in the upper extremities, based on the location of wearable sensors used, types of tasks performed by participants and the number of data collection sessions performed.	20	63.35 ± 9.63	13 M 7 F	Two type IMU sensors were placed on the dorsal part of each hand, in each tight proximal of the femur epicondyle, and on each forearm on top of the flexor carpi radialis. During each session, participants performed 13 different motor tasks. Clinician rated the severity of tremor, bradykinesia and dyskinesia in upper extremities for the left and right side, during the execution of each task.	A single wearable sensor on the back of the hand is sufficient for detecting bradykinesia and tremor, in the upper extremities, whereas using sensors on both sides does not improve performance. The prevalence of tremor was substantially lower and more variable than that of bradykinesia; 8 individuals showed dyskinesia during more than one task performance so the models for the detection of dyskinesia are not developed. PD symptoms can be detected during a variety of activities and are best modeled by a dataset incorporating many individuals.
Lukšys (2018)	Examine selected tremor parameters (frequency, root mean square and approximated entropy) in order to quantify the characteristics of persons with PD, compared with healthy persons, and compare the parameters by dividing persons with PD according to Unified Parkinson's Disease Rating Scale (UPDRS) assessment.	31 (PD 13 HS 12)	61.53 ± 10.81 57.83 ± 7.58	8 M 11 F 6 M 6 F	Three type IMU was used. For the quantitative estimation of kinetic and postural tremors, several parameters were selected and calculated from the measured angular velocity and linear acceleration signals. The finger-to-nose test for examining kinetic tremor features and holding an outstretched arm for examination of postural tremor features, were used for assessment.	Statistically significant differences between PD patients and control groups were observed in approximated entropy acceleration signal of kinetic tremor, approximated entropy angular velocity signal of kinetic tremor, approximated entropy angular velocity of postural tremor, frequency acceleration signal of postural tremor, and RMS angular speed kinetic tremor.

First author (year)	Aim	Sample characteristics			Method and assessed elements	Conclusion
		N	Age	Gend.		
Nguyen (2018)	Develop detection and segmentation algorithms based on IMUs to isolate activities of daily living (ADL) in persons with PD in a simulated free-living environment.	9	66.1 ± 2.7 M 66.5 ± 12.0 F	7 M 2 F	17 Three Type IMUs positioned on each limb, trunk, and head segment to capture full-body 3D movement. ADL such as *sit down* (on a chair), *stand up* (from a chair), *reach*(*ground*, *mid*, *high*), *walk,* and *turn* were identified for detection and segmentation	IMU demonstrated great accuracy in the detection of *sit down* and *stand up*, which could be used to measure performance in PD population. Reaching activities were detected with almost 90% sensitivity, but the accuracy decreases when reaching tasks are separated by levels. The beginnings and endings of *turn* were segmented with a median difference of 0.68s within the manual segmentation. *Turn* can occur abruptly during sharp angle (turn 180° or 90°) or more gradually during walking. Even with the largest variation (SD = 1.09s), *turn* was detected with almost 83% accuracy. Lastly, there were over 350 bouts of walking classified manually by the examiner and about 92% of it was detected using the sensors. Within the detected walking bouts, the differences between the manual and sensor segmentation was approximately 0.63s. The high detection rate and low segmentation time differences illustrate the potential of using IMUs in clinical setting to quickly measure and analyze the quality of movement in PD population.
Sijobert (2014)	Early detection of freezing of gait (FOG) and festination episodes in order to trigger functional electrical stimulation (FES) assistance. Detect results of FOG and festination detection, including frequency analysis and gait parameters (stride length and cadence) changes.	7	70 ± 5	6 M 1 F	One, two type IMU was used to detect freezing of gait and festination episodes, while a person walks along 20 meters long corridor (several dual tasks were proposed in order to maximize the number of FOG). IMU sensor data was processed in order to compute freezing index (FI), the ratio between the signal (limb acceleration) power in the "freeze" band and the signal power in the "locomotor" band) and freezing of gait criterion indexes (FOGC).	The FI method detected 32 of FOG episodes, and the FOGC method detected 41 of these episodes. Concerning the 31 main FOG events, FI "missed" 11 FOG events and FOGC missed only 5 of them. None of festination episodes was detected by the FI method whereas FOGC detected all of them. Stride length and cadence could for instance be interesting to observe in order to detect gait changes including FOG and festination.

First author (year)	Aim	Sample characteristics			Method and assessed elements	Conclusion
		N	Age	Gend.		
Zago (2018)	Investigate whether a commercially available inertial sensor can reliably provide basic spatiotemporal parameters in persons with PD, during a walking. Compare IMU applicability to a gold standard optoelectronic motion capture system.	22	69.4 ± 6.1	10 M 12 F	Three type IMU and the optical system was used to determinate eight spatiotemporal parameters describing the step cycle (cadence, velocity, stride length, stride duration, step length, stance, swing and double support duration). Results were compared between the two systems. The IMU and the optical system reported comparable gait parameters, with the exception of walking velocity.	All the gait variables measured with the two systems resulted to be not statistically different, with the exception of the gait velocity ($p<0.05$). Positive, high correlations were obtained for cadence, velocity, stride duration and stride length; positive, moderate correlation for the other parameters. All correlations were statistically significant. The IMU system is sufficiently accurate in the assessment of fundamental gait spatiotemporal parameters. The fast and simplified data recording process allowed by wearables makes this technology appealing and represents a possible solution for the quantification of gait in the clinical context, especially when using a traditional 3D optoelectronic gait analysis is not possible.

Legend: Gend.- Gender; M- male, F- female; HS- healthy subject, IMU- inertial measurement unit

Following the results of the analyzed studies, shown in Table 2, it is observed that the use of IMU plays a significant role in the assessment of various motor activities in individuals with PD. During assessment wearable sensors have to be fixed properly and firmly to the human body so as to avoid vibration artefact on the IMU measuring (Fusca et al., 2018). The aforementioned authors also emphasize that the bad alignment of the measuring could introduce drift in the measurement so this setup parameter has to be controlled and compensated. The use of different types of IMU is applied in the assessment of both the functioning of the upper and lower extremities and the overall motor functioning of the individual, as well as the detection of possible, accompanying difficulties in the implementation of the motor task.

To measure 3D linear accelerations and angular velocities in three axes (X, Y, and Z) from upper and lower limbs, four inertial measurement units (IMUs) were used, and each IMU provided inertial sensing via tri-axial accelerometer and tri-axial gyroscope. To capture as much as data from lower limbs during walking and foot tapping data, the IMUs were placed just above the ankle joints facing outwards, while to record the upper limb data during hand rotation and also walking, participants put on the IMUs next to the ulna bone on the outside of the wrist (Aghanavsi et al., 2020). All of sensors continuously recorded movement, when they were turned on, and readings included the acceleration and angular velocity measurements and the total stream of the signals was visualized. Identification of the walking signals was done by recognizing the signals for previous and later tests. The number of collected observations per motor tests was 224 for leg agility (LA), 230 for pronation-supination movements of hands (PSM) and 223 for walking. Results of study indicates that from upper-limb tests (PSM and ULM-W) the majority of the selected features were based on accelerometers (10 out of 18 for PSM, 8 out of 8 for ULM-W), whereas from lower limb tests (LA and LLM-W) the majority of the selected features were originated from gyroscope sensors (4 out of 7 for LLM-W, 4 out of 6 for LA). All of obtained results (from examining correlation of Treatment response index and reference scores) showed high correlation to dyskinesia, bradykinesia and gait, and low correlations to leg agility and pronation-supination movements of hands.

In the study of Nguyen et al., (2018) IMU was used for detection of characteristics in activities of daily living, such as sit down (on a chair), stand up (from a chair), reach (ground, mid, high), walk, and turn. For nine participants with PD, a simulated free-living apartment (7m x 8m) was set up to induce a daily living task of cleaning and all of objects were strategically placed throughout the apartment at different locations and heights. During assessment IMUs were positioned on each limb, trunk and head segment to capture full-body 3D movement. Each module contains a 3-axis accelerometer (linear acceleration), a 3-axis gyroscope (angular velocity), and magnetometer (magnetic north heading). While the method was developed using a continuous Timed Up and Go task, the fundamental processes of detecting and segmenting these activities remained the same. In the cleaning task, kinematics peaks were used to identify an activity and the maximum/minimum to the left/right of these peaks was used to estimate the duration (segmentation) of an activity (Nguyen et al., 2018). Sit down and stand up was detected using several kinematic data extracted from different IMUs and segmented using the acceleration of the trunk, the sacrum acceleration was added to ensure synchronicity of movement of the trunk and the hip during these activities, while the symmetry of the left and right hip flexion was used to discriminate from other activities such as reach ground, where PD participants often performed with one knee touching the ground. Walk was classified using the magnitude of the linear acceleration of the left and right IMU on the shin in the x and z direction. Reaching activities were detected using the normalized angle of the trunk, hip, knee, and shoulder. Authors in results of study indicate that across all activities, classification using the sensors signals was about 90% accurate (sensitivity = 89.8%, specificity = 97.9%). During sit down (N = 84), the median of the time difference between the manual and sensor segmentation was 0.34 s, during stand up 0.18 s, the three reaching activities, median difference was 0.2). Within the detected walking bouts, the differences between the manual and sensor segmentation was approximately 0.63 s. The high detection rate and low segmentation time differences illustrate the potential of using IMUs in clinical setting to quickly measure and analyze the quality of movement in PD population.

With aim to introduce a wearable bradykinesia assessment system, whose core component is composed of an inertial measurement unit, Dai et al., (2015), tracked the finger's activity by an inertial measurement unit (IMU) on the top side of the patient's middle finger, which includes a three-axis gyroscope and a three-axis accelerometer; the gyroscope is used as the primary source of orientation information, while the accelerometer is used for roll–pitch drift correction because it has no drift over time. Only the gravity vector of the accelerometer is used for the drift detection. A 10 second whole task was chosen as the assessment action in persons with PD. An IMU, attached to the middle finger, was used to measure the angular displacement of the middle finger during the bradykinesia assessment task. The hand grasping angles obtained from patients with mild bradykinesia have a consistent amplitude and frequency, and appear sinusoidal. However, hand grasping angles of persons with severe bradykinesia have much lower and more inconsistent amplitudes and frequencies. Speeds, amplitudes, halts, hesitations, and any decline in amplitude are evaluated. Results of evaluation indicate that the akinesia affects the cycles of the hand grasps, thus the dominant frequency was reduced. Calculated bradykinesia parameter (modified mean range, instead of mean and standard deviation of the grasp ranges) correlated well with the evaluations of a neurologist (Pearson's correlation coefficient $r = -0.83$, $p < 0.001$). Result also indicates that the age of subjects may influence performance of hand grasping, as well as that the modified mean range can be defined as the major parkinsonian bradykinesia parameter. Đurić-Jovičić et al., (2016) investigated the repetitive finger tapping patterns in persons with PD, and two other conditions (supranuclear palsy–Richardson syndrome- PSPR and multiple system atrophy of parkinsonian type-MSAP). Kinematic parameters followed by sensors were angle amplitude in degrees, cycle duration, speed. Tapping amplitude was defined as the angle between the long axes of the thumb and index finger, while closing and opening velocities were the peak velocities of aperture closure and opening within a cycle. The slope of change in amplitude was used to assess progressive hypokinesia or "decrement" and the slope of change in speed that encompassed both amplitude and duration was used to assess progressive slowing of movement. Obtained results showed that persons with PD had significantly shorter duration per cycle than healthy subjects and persons with PSPR. The amplitude slope in PSPR was significantly less negative compared to PD group. The amplitude and speed slopes were more negative in the PD and MSAP groups. In the PD group, 27.3% (3/11) of patients with hypokinesia were without decrement, while the remaining 72.7% (8/11) had hypokinesia with decrement (p = 0.0002).

Research based on recording movement data from 6 body-conforming flexible wearable sensors attached to the hands, arms, and thighs, and trained a machine learning classifier, with aim to detect the presence of tremor or bradykinesia in upper extremities, as individuals with PD performed a series of common daily activities and standard tasks used in clinical assessments, was conducted by Lonin et al., (2018). Obtained results indicate that the mean proportion of task performances showing symptoms across participants were 48.5% for bradykinesia, 22% for tremor, and 8% for dyskinesias. The prevalence of tremor was substantially lower and more variable than that of bradykinesia, with one participant showing no manifestation of tremor at all. Eight persons with PD showed dyskinesia during more than one task performance, while using data from sensors on both hands to detect symptoms did not significantly improve performance. Bradykinesia detection during fine motor tasks and walking yielded the highest mean across participants.

A nine degree freedom wireless inertial measurement unit, consisted from six wireless sensors, was used by Lukšys et al., (2018) to examine tremor parameters in order to quantify the characteristics of persons with PD in comparison with healthy persons. Used IMU was consisted from accelerometer, gyroscope and magnetometer. In order to reach the goal, each participant performed motor tasks specific do certain tremor: finger-to-nose test for examining kinetic tremor features and holding an outstretched arm for examination of postural tremor features. Several parameters were selected and calculated from the measured angular velocity and linear acceleration signals for quantification of kinetic and postural tremors (dominant frequency, root mean square-used to evaluate the intensity of tremors and approximated entropy[a]). Significant differences between PD patients and control groups were observed in approximated entropy acceleration signal of kinetic tremor, approximated entropy angular velocity signal of kinetic tremor, approximated entropy angular velocity of postural tremor, frequency acceleration signal of postural tremor, and root mean square angular speed kinetic tremor.

Gait and characteristics of walking are the areas of interest between many experts, who conduct researches with various aims. "Can gait features predict the presence of PD?" is one of the questions who asked Caramia et al., (2018) in their research. The measuring instrumentation in research of previously mentioned group of authors included the Motion capture system Tech-MCS, consisted of eight IMUs (each consisted from accelerometer, gyroscope and magnetometer), located in the lower and upper parts of the body (each foot dorsum, each shank, each thigh, chest and bon back side of lumbar zone). Range of motion and spatio-temporal parameters (step length, step time, stride time and stride speed) were extracted as parameters from raw data. The ability of IMU-based gait analysis to discriminate patients with PD at different severity stages from age-matched healthy individuals relevantly depend on the number and location of sensors used to extract the parameters. Best results were obtained with

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[a] Approximate entropy is a technique that quantifies the degree of irregularity and the unpredictability of fluctuations in time series data (Lukšys et al., 2018).

the knee range of motion, calculated with 4 IMUs, placed bilaterally. Spatio-temporal parameters also were examined in study of Zago et al., (2018). In mentioned study three type IMU and the optical system was used to determinate eight spatiotemporal parameters describing the step cycle (cadence, velocity, stride length, stride duration, step length, stance, swing and double support duration). For assessment of parameters authors implemented "Walk" protocol, which requires that the sensor must be placed at the L5 level by means of a provided elastic belt. Five trials were acquired with both the optoelectronic and IMU-based systems, asking participants to walk barefoot along a 10-m walkway at their self-selected walking speed. The values of the three central trials were used for systems comparison. Parameters, obtained with two systems, were not significantly different, with the exception of the gait velocity ($p < 0.05$), which was significantly higher in the measurements by the wearable system. Positive, high correlations were obtained for cadence, velocity, stride duration and stride length, while positive, moderate correlation was obtained for the other parameters. All correlations were statistically significant. By introducing a new approach for the observation of gait changes and the detection of FOG events, the so-called FOG criterion (FOGC) based on the continuous evaluation of two gait parameters: cadence and stride length, Azevedo Coste et al., (2014), used inertia sensor-based walking speed estimation methods. Namely, authors explain that this method is based on the segmentation of gait data into strides using gyroscopic data. Within each stride the acceleration data is integrated in order to obtain the forward leg displacement. The initial velocity of the leg at the stride onset is obtained using gyroscopic signal. At the end of the stride, a correction is performed. IMU signals and video were recorded during 1.730 s. Video from the sessions were analyzed by the neurologist who identified and labeled 44 freezing of gait episodes. IMU sensor data was processed in order to compute freeze index (FI; the ratio between the signal (limb acceleration) power in the "freeze" band and the signal power in the "locomotor" band) and FOGC indexes. The FI method detected 26 of these episodes and the FOGC method detected 35 of these episodes. Concerning the 26 main FOG events (labeled red and orange), FI "missed" nine FOG events and FOGC missed only four of them. On the end, authors conclude that the existing frequency-based freezing detectors are not sufficient to detect all FOG and festination episodes and the observation of some gait parameters such as stride length and cadence are valuable inputs to anticipate the occurrence of upcoming FOG. Similar method of detecting freezing of gait and festination episodes during walk in persons with PD was used by Sijobert et al., (2014). In this study IMU sensor data was processed in order to compute freezing index (FI), the ratio between the signal (limb acceleration) power in the "freeze" band and the signal power in the "locomotor" band) and freezing of gait criterion indexes (FOGC). After collected data, authors concluded that the FI method detected 32 of FOG episodes, and the FOGC method detected 41 of these episodes. Concerning the 31 main FOG events, FI "missed" 11 FOG events and FOGC missed only 5 of them. None of festination episodes was detected by the FI method whereas FOGC detected all of them. Stride length and cadence could for instance be interesting to observe in order to detect gait changes including FOG and festination.

According to the previously described results and procedures, IMU can be used in assessment of different characteristics of motor behavior, performances and motor symptoms in persons with PD. instruments has many advantages with "gold standard" considered system in terms of feasibility, portability and cost (Fusca et al., 2018). Besides a small sample size, the limitations of conducted and analyzed researches are insufficient and inadequate described testing procedures, applicability of non-standardized motor assessment tools in some research. Applicability IMU in work with persons with PD and other conditions, which can result in severe disability, can have a predictable role in the therapeutic process. As motion capture is available with IMU, application of them in different scientific areas can be useful as a toll for diagnostic of various conditions and diseases. IMU system represents a promising and viable alternative to the standard gait analysis systems (Zago et al., 2018), as well as other segments of motor behavior important for performing activities of daily living important for the improvement of quality of life in every person. Use of IMU will provide two major advantages: (a) overcome the intraindividual variability at different times of the day in a single person due to the disease fluctuations, thanks to prolonged recording times; (b) provide the staff with technology suitable to make accurate diagnoses, and to develop a more effective targeted therapy, thanks to objective, long-term measurements of treatment outcomes (Zago et al., 2018).

CONCLUSION

Parkinson's disease is second commonest neurodegenerative, motor disorder, which leads to the functional disability in elderly. Technology development, implementation of various diagnostic and therapeutic procedures, can decrease the percent of persons in advanced stage of PD. IMU based assessment of motor behavior and kinematic characteristics can be support in aforementioned process.

The analyzed researches has shown that the IMU can be used in evaluation of motion range and amplitude, characteristics of movements and activities important for everyday living, gait characteristics, as well as PD related symptoms, such as bradykinesia, tremor, festination, freezing of gait. Sensors, consisted in IMU, also can be fused together to provide a 3D picture of human motion.

The importance of this systematic review article is oriented toward contributing to the creation of a general viewpoint on the implementation of IMU in the assessment of motor task performance in persons with PD. Around the world and in our country, a small percent of studies are based on the assessment of persons with PD with the use of IMU. The previously mentioned fact represents a proper foundation for a comprehensive consideration of the problem in further studies.

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QUANTITATIVE INDICATORS OF UPPER EXTREMITY MUSCLE POTENTIAL IN INDIVIDUALS WITH SPINAL CORD INJURY – PARAPLEGIA: A PILOT STUDY

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SUMMARY

This study aimed to present quantitative indicators of muscle potential of the upper extremities in persons with spinal cord injury – paraplegia. For the purposes of the research, the isometric dynamometry method and standardized handgrip test were applied. A total of 15 males participated in the study, of which 12 subjects had complete and 3 subjects had incomplete spinal cord injury, mean age 46.66 ± 8.28 years. They have undergone a rehabilitation phase and at least 12 years have passed since the spinal cord injury. All subjects moved using standard mechanically powered wheelchairs and all were right-handed. Maximum values of muscle potential (maximal muscular force of the left hand and the right hand expressed in N, time aspect of force manifestation at 50% of maximum expressed in s, endurance in force expressed in Ns, as well as summary values of muscle potential) and functional dimorphism were analyzed. All results are presented in absolute and relative values of muscle potential. The maximum handgrip of the left hand was 448.79 ± 85.58 N, and 490.55 ± 79.06 N for the right. The research results show that the summary value of the muscle potential of the hand strength was 939.34 ± 163.21 N, whereas the relative value was 11.30 ± 2.49 N/kg. The functional dimorphism for the maximum handgrip between the non-dominant and dominant hand was 0.912 ± 0.05. The summary value of the muscular potential for endurance at 50% of the maximum was 28004.67 ± 11233.66 Ns, while the relative value was 334.82 ± 129.65 Ns/kg. The functional dimorphism for of endurance in force was 0.793 ± 0.11. Based on the results, changes in functional independence and motor abilities of persons with spinal cord injury during and after rehabilitation could be monitored.

Key words: spinal cord injuries, handgrip, muscle potential, functional dimorphism, endurance in force

INTRODUCTION

Paraplegia represents impairment or loss of motor and sensory functions in the thoracic, lumbar, or sacral segments of the spinal cord due to a lesion of neural elements in the spinal canal. In paraplegia, the function of the upper extremities is preserved and depending on the neurological level and completeness of the lesion, the function of the trunk, lower extremities and pelvic organs may be impaired. The most intensive recovery occurs in the first few months after the spinal cord lesion, after which the dynamics are maintained or slowed down (Jović, 2011). Baldi et al., (1998) state that total muscle mass decreases by 9.5% in the first 6 months, while lower extremity muscle tissue decreases by 15.1% in the first year after spinal cord injury (Wilmet et al., 1995). People with spinal cord injury (hereinafter referred to as SCI) lead a sedentary lifestyle; their needs, abilities and limitations change over time and most are physically inactive (Anneken et al., 2010).

In the rehabilitation phase, ie the so-called mobilization phase, people with SCI are trained for the use of wheelchairs, for which they need adequate strength, endurance and power of the muscles of the upper extremities and torso. It should be noted that spinal cord injuries above the twelfth thoracic vertebra lead to impaired postural balance in the sitting position, which increases the load on the upper extremities (Zoeller et al., 2005). In addition to the basic activities of moving a wheelchair forward, back, right and left, transfer training plays an important role. It involves moving from the bed to the wheelchair and vice versa, then moving to a chair, on a mat, to the toilet, in a car, opening and closing the door, lifting objects off the floor and so on (Jovanović et al., 2016). This is followed by training in mastering the architectural characteristics of the surrounding in which a person with SCI lives, which relate to driving on an oblique plane – ramps, entering and exiting elevators, as well as moving in public buildings and public transport. All of the above is especially important when rehabilitation is completed, upon return to the family and social environment (Jović, 2011). Functional independence and performance of daily activities will depend on the level of motor abilities (Ribeiro Neto et al., 2017).

However, reduced physical capacity is a common feature of all individuals who have experienced spinal cord injury, and is the result of a loss of motor control, muscle atrophy, and additional inactivity (Martin Ginis et al., 2010). The ageing process itself can accelerate and thus intensify changes in the musculoskeletal system resulting from cumulative stresses, especially the upper extremities and the shoulder girdle. In addition, atrophy due to inactivity occurs much faster than atrophy that occurs with ageing. Due to inactivity, the volume of movement in the joints and the elasticity of the soft tissues decrease over time, the need for energy is reduced, and the reduced muscular work weakens the heart strength (Jovanović et al., 2016).

The mobility of people with SCI is also influencedby the presence of secondary complications, secondary urinary infections, muscle spasms and pressure ulcers (Milićević et al., 2012). Moreover, people who lead a sedentary lifestyle are more likely to gain weight, especially people with SCI, which is an aggravating factor in everyday functioning (deGroot et al., 2010). Overall, reduced self-care ability associated with a higher upper extremity load increases physical effort, causing fatigue and distress (Janssen et al., 1996).

One of the focuses of the research, which is conducted in order to improve the quality of life of people with SCI, is to find ways to reduce physical stress during functional activities and to preserve upper-limb health (Chow & Levy, 2011). Studies in the field of biomechanics contribute to the understanding of the factors responsible for producing the muscular strength of preserved muscles, in terms of increasing the efficiency of wheelchair mobility (van der Woude et al., 2001). The analysis of kinematic and kinetic variables determines the most loaded joints and segments of the musculoskeletal system of persons with SCI (Larraga García et al., 2019). Then, there are dynamometric methods that that are used for examining the strength of postural muscles, as well as for the evaluation of the muscle strength of the upper extremities (Sisto & Dyson Hudson, 2007).

Assessment of maximal grip strength has proven to be a good indicator of the total strength of the upper extremities (Wang et al., 2018) and the overall neuromuscular system (Chan et al., 2008). A more recent study shows that the measurement of the maximum handgrip and the relationship between the non-dominant hand and dominant hand can predict disability in everyday activities during the ageing process (Mc Grath et al., 2020).

Assessment of the muscle force of the finger flexors by isometric dynamometry method is applied to test the contractile abilities of the hand muscles. This simple and non-invasive test is an indicator of qualitative and quantitative muscle functions. By using modern testing devices with a state-of-the-art hardware-software system, which uses very high-sensitivity tensiometric probes, it is possible to record force change in a unit of time of over 100 MHz/s. Such a speed of data acquisition provides an opportunity to analyze the record of the change in force in a unit of time concerning the very structure of the mechanical manifestations of the observed contraction. Therefore, it is possible to analyze all the mechanical characteristics of the force record (Dopsaj et al., 2009). Thus, using this test, data on the level of development of the maximum force (Maximal grip strength – F_{max}) or explosive force (Rate of Force Development – RFD) of the tested muscles can be obtained, as well as data on the capacity to maintain a given level of force (Isometric endurance), usually at 50% of maximum, on the time aspect of force manifestation in a certain percentage (usually at 50% – $tF_{max}50\%$) and the time required to exhibit a specific level of explosive force ($tRFD_{max}$). From the obtained data, summary ($F_{max}SUM$) or relative values can be further calculated by the classical or allometric method (relative value of maximal isometric handgrip force – $F_{max}REL$), but also functional dimorphism and force impulse (ImpF) (Ivanović & Dopsaj, 2012).

The results of an examination of various parameters obtained by the method of isometric dynamometry show that this method can be used both in young and healthy persons (Kljajić et al., 2012) and in the elderly (Trajkov et al., 2018).

The subject of this study is an examination of the muscle potential in individuals with SCI. Namely, the basic function is to provide a muscle contraction, that is, to be activated from the state of physiological tone into some desired tone, which depends on the intensity of the internal voluntary or external involuntary stimulus. Potential, at the level of physical manifestation of muscle tone, is measured over the realized mechanical magnitudes of the analogue output of the achieved tone and is expressed in physical quantities of the same (Dopsaj et al., 2002).

This pilot study aims to present quantitative indicators of upper extremity muscle potential in individuals with SCI – paraplegia. The results can be used for further research in a population of persons with different levels of spinal cord injury, as well as in other persons with disabilities who use wheelchairs.

RESEARCH METHOD

Subject

The sample consisted of a total of 15 males, aged between 30 and 60, who had a spinal cord injury – paraplegia and who were wheelchair users. The criterion was that the subjects had undergone a rehabilitation phase, had no injuries or pain in the upper extremities lately, and that they were not involved in any sport regularly. Subjects were beneficiaries of the Home for Adult Disabled Persons in Zemun, they were familiar with the testing conditions and voluntarily participated in the research. First, they filled out a general questionnaire designed for general research purposes, and then the measurement was conducted. The basic anthropometric indicator – body height (BH, cm) was taken from the medical records of the participant, while the last measurement of body weight (BM, kg) was taken as a valid data. All subjects stated that their right hand was dominant. Characteristics of the subjects related to age, time after injury, a spinal cord injury level and completeness of injury (by ASIA scale) are shown in Table 1. Additionally, Table 1 shows anthropometric indicators of body height, body weight and body mass index (BMI).

Table 1. *Characteristics of subjects in relation to age, spinal cord injury and anthropometric indicators*

	M	SD	cV%	Min	Max
Age (years)	46.66	8.28	17.74	32.4	59.9
Time after injury (years)	21.27	8.69	40.84	12.3	44
BH (cm)	179.79	6.96	3.87	168	193
BM (kg)	84.64	12.10	14.30	63	103
BMI (kg/m^2)	26.20	3.66	13.97	22.10	34.60
Level of injury n (%)	Thoracic 9 (60%)	Lumbar 6 (40%)			
ASIA n (%)	A (complete) 12 (80%)	B (incomplete) 2 (13.33%)	C (incomplete) 1 (6.67%)		

The research was carried out following the conditions of the Declaration of Helsinki, with the approval and consent of the Ethics Committee of the Faculty of Sport and Physical Education, University of Belgrade (484-2).

METHOD

A test for the evaluation of the muscular force of the finger flexors – the isometric dynamometry method was used in the study (Dopsaj et al., 2011). Testing procedure: after a 5 minutes self-warming up of the general character, the testing procedure was explained to each participant, after which the participant made two trial hand grip attempts (with left and right hand) to perform specific warm-ups. After a 5-minute break, the participant proceeded to the test protocol. First, two alternating measurements of the maximum handgrip of both hands (first dominant, then non-dominant hand) were performed with a break of at least 1 minute between each attempt to test one hand. After calculating the force values for each hand at the level of 50% of the maximum ($F_{50\%L}$ for the left arm and $F_{50\%R}$ for the right arm), a rest of 10 minutes was provided. Then, the measurement of the force manifestation capacity (endurance of the expression of isometric muscle force) was conducted, that is the time interval during which the subjects could maintain the required level of atthe 50% of the maximumlevel. Testing was performed in a sitting position, in a wheelchair (Figure 1).

Figure 1 – Muscle force testing – isometric dynamometry method

Variables

- *Absolute values of muscle potential:*
  - A maximal muscular force of the left hand and the right hand ($F_{maxL}$and F_{maxR}), expressed in newtons (N);
- The time aspect of the manifestation of a given percentage of force:
  - Time of carrying out the muscle force of handgrip at 50% of the maximum handgrip value with the left and right hand – $tF_{50\%L}$ and $tF_{50\%R}$, expressed in seconds (s).
- Endurance of the force:
  - An impulse of the muscular force of the handgrip with the left and right hand at 50% of the maximum handgrip force – $I_{mp}F_{50\%L}$ and $I_{mp}F_{50\%R}$, expressed in newton-second (Ns).

- *Total muscle potential – hand strength* refers to the sum of the maximum left and right hand grip force expressed in newtons (N) – $F_{max}SUM$, where $F_{max}SUM=F_{max}L+F_{max}R$.

- *Total muscle potential – the time of maintaining the given force*refers to the sum of the time of maintenance of a level of muscular force at 50% of the maximum value of handgrip of the left and right hand, expressed in seconds (s) – $tF_{50\%}SUM$, where $tF_{50\%}SUM= tF_{50\%}L+ tF_{50\%}R$.

- *Total muscle potential* – *endurance* refers to the sum of the absolute values of the endurance in the force – the impulse of the muscular force of the handgrip of the left and right hand at 50% of the maximum force of handgrip, expressed in newton-second (Ns)– ${}_{imp}F_{50\%}SUM$, where ${}_{imp}F_{50\%}SUM={}_{imp}F_{50\%}L+ {}_{imp}F_{50\%}R$.

- *Relative values of total muscle potential:*
  - Relative hand strength – $F_{rel}SUM$, expressed in newton per kilogram of body weight (N/kg), where $F_{rel}SUM= F_{max}SUM/BM$.
  - Relative time of maintaining the level of muscle force at 50% of the maximum value of the left and right handgrip per kilogram of body weight– $tF_{50\%}SUM_{rel}$,

expressed in seconds per kilogram of body weight (s/kg), wheret $F_{50\%}SUM_{rel}$ = $tF_{50\%}SUM/BM$.

- Relative value of muscle endurance – ${}_{imp}F_{50\%}SUM_{rel}$, expressed in newton-seconds per kilogram of body weight (Ns/kg), where ${}_{imp}F_{50\%}SUM_{rel} = {}_{imp}F_{50\%}SUM/BM$.

- *Functional dimorphism*is defined as the index relation of the analyzed force characteristics, the time of expression of a given force and the force impulse of the non-dominant (left) and dominant (right) hands of the subjects:

- Relationship between the maximum muscle handgrip force of the non-dominant and dominant hand – $F_{max}L/R$;
- Relationship between the time of realization of the muscular force of the handgrip at 50% of the maximum of the non-dominant and dominant hand – $tF_{50\%}L/R$;
- Relationship between the absolute value of the impulse of muscle force at 50% of the maximum of the non-dominant and dominanthand – $I_{mp}F_{50\%}L/R$.

Statistical data processing

All results were analyzed using the descriptive statistical method, where the following were calculated: measures of central tendency (mean value of a variable – arithmetic mean) measures of variability (standard deviation – SD, coefficient of variation – cV%), range limits (minimum – Min andmaximum – Max). Statistical data processing was performed using the software package Exce 2003 (Microsoft®Office Excel 2003).

RESULTS

Table 2 shows the results of the descriptive statistical measure of the examined variables. The results show that the coefficient of variation, as a basic measure of estimating the homogeneity of the raw data, ranged from 16.12% to 42.95%. For more than half of the variables the value of the coefficient of variation is in the zone less than 30% and less in the zone of moderately homogeneous results (the zone between 30-60%), so these data can be interpreted at the population level as generally reliable. The maximum handgrip averaged 448.79 ± 85.58 N for the left hand and 490.55 ± 79.06 N for the right hand. Concerning the endurance at 50% of the maximum force of the handgrip, and presented as a force impulse, our subjects had values for the left hand of 12329.06 ± 5295.52 Ns on average and 15675.62 ± 6097.96 Ns for the right hand.

Table 2. *Results of basic descriptive statistics of variables of muscle force, time of manifestation and endurance in force*

	M	SD	cV%	Min	Max
F_{maxL} (N)	448.79	85.58	19.07	258	637
F_{maxR} (N)	490.55	79.06	16.12	284	639
$F_{50\%maxL}$ (N)	224.39	42.79	19.07	129	318.50
$F_{50\%maxR}$ (N)	245.28	39.53	16.12	142	319.50
$tF_{50\%L}$ (s)	54.55	15.69	28.75	28.25	88.19
$tF_{50\%R}$ (s)	63.72	19.13	30.02	25.52	98.71
$I_{mp}F_{50\%L}$ (Ns)	12329.06	5295.52	42.95	7073.82	28088.52
$I_{mp}F_{50\%R}$ (Ns)	15675.62	6097.96	38.9	7043.52	30758.27

Summary and relative indicators of total muscle potential are shown in Table 3. Summary indicators refer to the sum: the maximum muscular force of left and right handgrip, then the time of maintaining muscle force level at 50% of the maximum value of the left and right handgrip and strength endurance – the impulse of a muscular force of left and right handgrip on 50% of the maximum handgrip force. Relative indicators of total muscle potential are represented by absolute values in relation to a kilogram of body weight. The table shows that the relative strength of the hands expressed per kilogram of body weight was 11.30 ± 2.49 N/kg, while the relative value of muscle endurance expressed per kilogram of body weight was 334.82 ± 129.65 Ns/kg.

Table 3. *Results of descriptive statistics of total muscle potential of hand – summary and relative indicators*

	M	SD	cV%	Min	Max
$F_{max}SUM$ (N)	939.34	163.21	17.38	542	1276
$tF_{50\%}SUM$ (s)	118.27	33.96	28.71	53.77	184.46
${}_{imp}F_{50\%}SUM$ (Ns)	28004.67	11233.66	40.11	14148.40	58846.78
$F_{rel}SUM$(N/kg)	11.30	2.49	22.07	6.53	15.81
$tF_{50\%}SUM_{rel}$ (s/kg)	1.42	0.44	31.17	0.72	2.18
${}_{imp}F_{50\%}SUM_{rel}$ (Ns/kg)	334.82	129.65	38.72	179.64	571.33

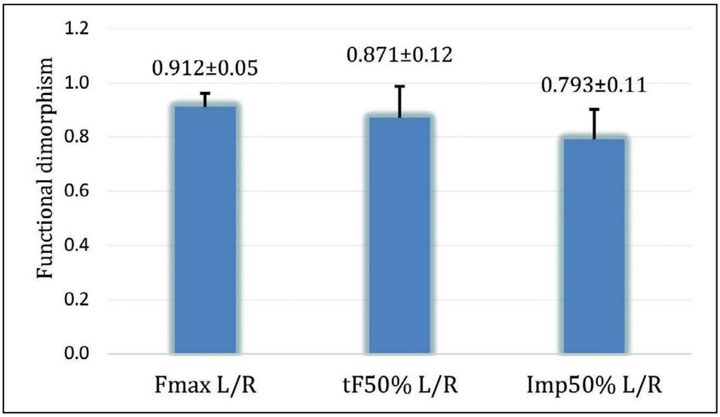

Figure 2. Functional dimorphism of the analyzed force characteristics, time of manifestation of a given force and force impulse

Figure 2 shows the index relation (functional dimorphism) of non-dominant (left) hand and the dominant (right) hand of the subjects in relation to maximum muscle force of handgrip, time of realization of muscle force of handgrip 50% of maximum and the absolute value of muscle force impulse 50% from the maximum.

DISCUSSION

The morphological characteristics and motor abilities are mainly determined by an individual set of endogenous and exogenous factors. Science has achieved significant results in discovering, studying and developing human capabilities, whereas improving the functioning of people with disabilities is an important goal of rehabilitation. Good knowledge of morphological changes that occur as a result of spinal cord injury is the basis of knowledge for those characteristics that we can influence, and these are primarily the motor abilities of the upper extremities. Their testing and measurement give us a starting point for examining the current state, as well as the changes that may occur either by additional inactivity or application of some form of physical activity. The study aimed to present quantitative indicators of upper extremity muscle potential in persons with SCI – paraplegia using a test for the evaluation of the muscular force of the finger flexors – the isometric dynamometry method.

Our subjects were males, who had a body mass index of 26.20 ± 3.66 kg/m^2 (Table 1). According to the classification of the World Health Organization, this classifies them in the group of "overweight" people, because the BMI ranges between 25 and 29.9 kg/m^2 (WHO: BMI Classification, 2020). Because people with SCI lead a sedentary lifestyle, they could be expected to have higher BMI values, as the time after injury averaged 21.27 ± 8.69 years. However, one should bear in mindthe fact that BMI increases in people with spinal cord injury from 2.8 to 3.4 units every 6 years (deGroot et al., 2010). By comparison, in a healthy human population, ageing increases BMI by 1 unit every 5 years (Nooyens et al., 2009). For our research, these data are of great importance because additional weight represents a greater load on the joints of the upper extremities. As far as the wrist joints are concerned, the greatest loads are in the propulsion phase, which starts from the beginning of pushing the wheels and lasts until the phase of returning the hands. The efficiency of wheelchair movement will depend on the mobility of these joints, the muscles that participate in the stabilization and compression of the hand, as well as the rolling resistance (Aleksandrović et al., 2016).

The maximum value of handgrip in our subjects was 448.79 ± 85.58 N and 490.55 ± 79.06 N for the left and the right hand, respectively. The difference in favour of the right hand was expected because all subjects reported the right hand as dominant (Table 2). If we compare our results with the results of a 2015 study where male subjects had maximum handgrip values of 560.9 ± 91.9 N and 620.6 ± 101.9 N for the left and the right hand, respectively, we can find that our subjects had a maximum handgrip less by 25.2% for the left hand, and 26.5% for the right hand (Trajkov et al., 2015). These subjects, like the ones from our research, were not systematically engaged in any physical activity and were overweight, given that their BMI was 26.7 ± 3.15 kg/m^2. The only difference was that they were younger than our subjects by an average of 8.48 years.

Comparing our results with the normative data of other populations aged 30 to 60, we come across some differences. Thus, adult male Korean subjects have significantly weaker handgrip. According to the data, depending on age, the average values of the handgrip for the right hand ranged on average from 40 kg to 42 kg (392 N to 411 N) and from 39 kg to 41 kg (382 N to 402 N) for the left hand (Lim et al., 2019). In Brazilian subjects, 42.8 kg (419 N) was found for the right hand, whereas 40.9 kg (401 N) was found for the left hand on average (Schlüssel et al., 2008). The average value of the right handgrip in Greek male subjects of similar age with lower extremity injury was 123 lbs (547 N), while for the left hand it was 111 lbs (493 N) (Mitsioniset et al., 2008).

The research published in 2018 (Marković et al.) shows the results of the maximum handgrip closer to our results (520.5 ± 107.4 N for non-dominant and 557.6 ± 112 N for dominant hand). The finding would indicate that our subjects were less successful in this test by an average of 14.8%. This result is understandable since subjects were also male, aged between 35 and 49.9 years, while the average age in our study was 46.66 years.

Most activities of everyday life require effort over a certain period. In addition to the maximum muscle strength of the handgrip, as an indicator of the function of the upper extremities, measuring the static endurance of the flexor muscles of the hand and fingers can provide a complete picture of hand function and overall functional capacity of healthy individuals. Furthermore, the examination of these variables in people with SCI is important in order to monitor changes in the musculoskeletal system, especially since it is known that higher muscle strength is associated with higher aerobic strength and endurance in people with paraplegia (Zoeller et al., 2005).

As in most previous studies that examined endurance as a measure of time, test protocols were based on maintaining maximum or submaximal levels of muscle contraction (30%, 50%, or 80% of Fmax). In previous studies, it has been observed that the endurance time increases with a decrease in a given submaximal force, which is also true for absolute and relative indicators of force impulse (Kljajić et al., 2012). Staszkiewicz et al., (2002) concluded that a static test with a load set at 50%

of maximum force (F_{max}) is the most important description of endurance in isometric submaximal contractions.

The results of our research, which refer to the time aspect of the endurance of a given level of force of 50% of the maximum, show that the subjects of the current study were more successful in relation to the general population. Namely, in our subjects, the endurance in force at 50% of the maximum was 54.55 ± 15.69 s for the non-dominant hand and 63.72 ± 19.13 s for the dominant one (Table 2). These results were compared with the research results from 2012, which included subjects twice younger than ours and who had a time of manifestation of force at 50% of the maximum of 49.03 ± 11.2 s for the non-dominant hand and 55.12 ± 9.69s for the dominant one (Kljajić et al., 2012). Therefore, it was noticed that our subjects had higher endurance because they maintained the required level of force longer, 5.52 s with the left hand and 8.6 s with the right hand, which is on average 12% longer.

Very similar results were presented in a study published earlier (Dopsaj et al., 2011). The main difference is that the subjects were students of the Criminal Police Academy who are considered to have a significant level of motor skills. The endurance of our subjects was higher by 14%, both concerning the left and the right hand, from the time aspect of endurance in force to 50% of the maximum. These results show greater endurance in subjects with SCI, which may be related to the fact that endurance is affected by repetitive movements of lower intensity and longer duration, such as wheelchair movement.

The average value of the force impulse, which is also an indicator of endurance in force, in our subjects was 12329.06 Ns for the left hand and 15675.62 Ns for the right hand. However, the relationship between the left and right hand – the index of functional dimorphism of endurance in force was 0.793, which means that the left hand makes 79.3% of the value of endurance of the right hand (Figure 2). This difference is unusual because our subjects reported that they had no musculoskeletal problems with the upper extremities, and what they all had in common was that they were wheelchair users, which requires equal use of both upper extremities. Chatterjee & Chowdhuri (1991) stated that in their subjects, the dominant arm also had greater endurance than the non-dominant one and that this did not always have to be the rule.

Moreover, endurance can be tested by both repeated dynamic contraction as well as repeated contraction on an isokinetic dynamometer. In this way, the results of our subjects might be clearer, since the kinematics of the wheelchair has a propulsive phase (repulsion phase) and a retropulsive phase (return phase to the beginning), where the force of handgrip and relaxation is manifested in a short period. For example, the retropulsive phase, which lasts from the moment the hand separates from the wheel frame and returns to the starting position for a new push, lasts on average 65-75% of the entire propulsive process, which is the period of relaxation of the muscles involved in the handgrip (Aleksandrović el al., 2016).

By comparing the maximum value of the left and right handgrip, ie non-dominant and dominant, it can be noticed that the value of functional dimorphism is 0.912 ± 0.05, which means that the right hand is stronger than the left by 8.8% (Figure 2). This result confirms the well-known fact that the dominant hand is about 10% stronger than the non-dominant one (Kolev & Halacheva, 2015).

The total muscle potential of hand strength, ie muscle force of the left and right handgrip was 939.34 ± 163.21 N. When we relativize it, we get that per kg of body weight the muscle potential of hand strength was 11.30 ± 2.49 N/kg. Concerning the time of maintaining the given force, the relative values averaged 11.42 ± 0.44 s/kg. The total muscular potential of endurance, which refers to the sum of absolute values of endurance in force – the impulse of the left and right handgrip at 50% of the maximum force of handgrip, was 28004.67 ± 11233.66 Ns, while relative values were 334.82 ± 129.65 Ns/kg (Table 3).

Muscle strength and endurance are two different dimensions of the contractile ability of skeletal muscles. Both components can be significantly impaired in people with SCI. Therefore, it is essential to develop the endurance measurement and analysis methods in addition to traditional tests of maximal strength. It is also essential to include endurance measurements in a standard assessment of upper extremity functionality in people with paraplegia. It would be useful to examine the endurance of people with paraplegia in relation to physical activity or some other parameters in future studies.

CONCLUSION

This study aimed to show quantitative indicators of the muscle potential of the upper extremities in people with spinal cord injury – paraplegia. The research results showed that the maximum handgrip of the left hand was 448.79 ± 85.58 N and 490.55 ± 79.06 N for the right hand. The summary value of the muscle potential of the hand strength was 939.34 ± 163.21 N, whereas the relative value was 11.30 ± 2.49 N/kg. The functional dimorphism for the maximum handgrip between the non-dominant and dominant hand was 0.912, ie the right hand was 8.8% stronger than the left hand. The summary value of the muscular potential for endurance at 50% of the maximum was 28004.67 ± 11233.66 Ns, while the relative value was 334.82 ± 129.65 Ns/kg. The functional dimorphism for of endurance in force showed that the right hand had a higher endurance than the left hand by 20.7% (the index of functional dimorphism was 0.793).

In this study, the relative values of upper extremity muscle potential for people with SCI were presented for the first time. Also, functional dimorphism in wheelchair users was examined for the first time, using the isometric dynamometry method. The obtained results could further serve the purpose of measuring these abilities in persons with different levels of spinal cord injury, as well as in other conditions where wheelchairs are used for mobility. Also, changes in functional independence and motor abilities during and after rehabilitation, the impact of physical activity and sports, but also inactivity could be monitored, as well.

Study limitations relate to the sample size. Subsequent research should include female subjects, as well as with subjects who have other pathological conditions, and use mobility aids.

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SOCIO-DEMOGRAPHIC CORRELATES OF INTERNALIZED STIGMA AND EMPOWERMENT IN A SAMPLE OF PEOPLE WITH PHYSICAL DISABILITIES

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SUMMARY

Advances in understanding internalized stigma and empowerment in people with physical disabilities as well as factors which could enhance developing stigma resistance is vital for their better quality of life and psychological well-being.

The aim of the cross-sectional study was to explore socio-demographic correlates of internalized stigma and empowerment in a sample of people with physical disabilities.

The sample consisted of 119 persons with different kind of physical disabilities, of different age (18-70), of various levels of education, employment, marital and living status. Self-stigma was assessed using Internalized Stigma of Mental Illness Scale. Subjective feelings of empowerment were assessed using the Boston University Empowerment Scale. As for socio-demographic variables, significant differences were found regarding the age, level of education, employment, residential and marital status. Stigma is more internalized by unmarried participants, younger, participants living in extended families, not living in their own apartments, with lower level of education and unemployed. Gender differences were not found. Lower level of empowerment is established in participants with lower level of education, unemployed, those who were younger, not living in their own apartment. Demographic variables appeared to have considerable importance for the processes of internalizing stigma in the population of people with physical disabilities. The results of the study suggest designing an anti-stigma campaign with respect to socio-demographic correlates, which could empower and provide better quality of life for people with disability in Serbia.

Key words**:** empowerment, internalized stigma, physical disability, socio-demographic variables

INTRODUCTION

Understanding disability as a medical problem that comes from within the person has been shifted to the models that define disability beyond simple medical explanations. For example, the Social Model of Disability understands disability as a socially defined problem and puts an emphasis on barriers that people with disabilities face in everyday life. According to this model, “disability is not a personal characteristic but is instead a gap between personal capability and environmental demand” (Verbrugge & Jette, 1994, p.1). Likewise, the Human Rights Model focuses on the dignity of human beings, where, in the context of disability, four values are of particular importance: dignity, autonomy, equality and solidarity. Recognizing the value of human dignity serves as a reminder that persons with disabilities have a place in society and are entitled to that place with dignity (Quinn, Degener, & Bruce, 2002). Despite core concepts the Social Model of Disability and the Human Rights Model have proposed people with disabilities are still discriminated within society (Tervo & Palmer, 2004; Vilchinsky, Findler, & Werner, 2010). Similarly, Miller and Major (2000) suggested that social stigma can negatively influence the quality of life of people with physical disabilities.

Therefore, we were interested in exploring socio-demographic factors which could help us to understand individual vulnerability to the stigma, more specifically, internalized stigma. Internalized stigma is experienced when a person is aware of stereotypes that describe stigmatized group that he/she is a member of, agrees with them and finally apply it to oneself (Corrigan, Larson, & Ruesch, 2009). Furthermore, internalized stigma is defined as "...subjective process taking part in specific social-cultural context, depicted by negative feelings toward oneself, maladaptive behavior, identity transformation, stereotypes acceptance emanating from personal experience, perception or anticipation of negative social reactions based on particular health condition" (Livingston & Boyd, 2010, p.2151). Therefore, internalized stigma is associated with various psychosocial outcomes such as poor quality of life low empowerment, reduced self-efficacy and self-esteem, and hopelessness (Lysaker, Roe, & Yanos, 2007; Taft, Ballou, & Keefer, 2013).

One of the psychological constructs important for a person's well-being and life satisfaction is empowerment. Empowerment is an important factor for overcoming stigma, so it is often thought that empowerment and internalized stigma are two poles of a continuum (Watson & Larson, 2006). A number of scholars were interested in exploring this construct, which resulted in a number of different definitions (e.g., Clark & Krupa, 2002; Rappaport, 1987; Segal, Silverman, & Temkin, 1993). Empowerment can be defined as "a process, a mechanism by which people, organizations, and communities gain mastery over their affairs" (Rappaport, 1987, p.122), or as a process of gaining control over one's life and influencing organizational and societal structure in which one lives (Segal et al., 1993), or as "an individual or group process that increases personal control by way of critical thinking, action and power sharing, that ensures dignity and equity through social exchange" (Clark & Krupa, 2002, p. 342). In summary, empowerment is important for an individual to feel having their life and actions under personal control. This particularly can be questionable regarding people with physical disabilities as very often decisions have been made for them, such as from their caretakers. Thus, exploring factors which could contribute to empowerment would give us a valuable insight how to support people with physical disabilities.

Socio-demographic variables associated with internalized stigma and empowerment

Examining relationship between psychological constructs and socio-demographic variables is important as it helps us to understand which categories of people are more vulnerable in developing internalized stigma and consequently in decreasing levels of empowerment. In people with mental illness and with disabilities, findings pertinent to association between socio-demographic characteristic and internalized stigma are not consistent.

Findings related to gender are diverse. In the studies conducted with participants with intellectual disability (10% had mobility problems; Ali, King, Strydom, & Hassiotis, 2016) and bipolar disorder and depression (Brohan, Gauci, Sartorius, Thornicroft, & GAMIAN–Europe Study Group, 2011) no relationship between internalized stigma and gender was found On the other side, among participants with mental illness men had higher internalized stigma scores than women (Krajewski, Burazeri, & Brand, 2013). Due to mixed results related to associations between gender and internalized stigma we hypothesized that no difference among man and women with physical disabilities exists in expressed levels of internalized stigma.

Findings regarding associations between age of the participants and internalized stigma are also mixed. While some studies did not find correlation between these constructs (e.g., Kamaradova et al., 2016) other showed that degrees of internalized stigma increased with the age (Ali et al., 2016). Further research is needed to examine relationship between gender and age of the participants and internalized stigma.

In regard to level of education, few studies found that participants with mental illness and inflammatory bowel disease who had higher level of education reported less internalized stigma (Brohan et al., 2011; Krajewski, Burazeri, & Brand, 2013; Taft et al., 2013). These results are somewhat expected as people with higher levels of education are more likely through their university experiences to develop relationship with peers which consequently can mitigate stigma internalization. Thus, we would expect to see lower levels of internalized stigma among people with physical disabilities with university degrees in comparison to the ones with high school diploma.

Furthermore, marital status could be a protective factor of perceived discrimination (e.g., Schulz & Decker, 1985). Accordingly, people with mental illness in Czech Republic who were married or in a relationship had a lower levels of internalized stigma (Kamaradova et al., 2016), while married Serbian people with physical disabilities less perceived discrimination than unmarried participants (Milačić Vidojević, Tošković, Dragojević, & Čolić, 2017). Based on the current findings, we expect that married participants report lower degrees of internalized stigma in comparison to unmarried participants.

Employment status was significantly associated with levels of internalized stigma. Particularly, employed participants had lower scores of internalized stigma, compared to unemployed participants (Brohan et al., 2011; Krajewski, Burazeri, & Brand, 2013). Presented findings show that more educated individuals and the ones who were employed had lower scores of internalized stigma. It could be that the ones who have higher education are also the one who are employed as well.

Presented findings related to associations between different socio-demographic correlates and internalized stigma and empowerment are mainly obtained in a sample of people with mental illnesses. To the best of our knowledge, these associations were not examined in people with physical disabilities. Therefore, our study aims to fill in gaps related to relationship among socio-demographic characteristic and internalized stigma and empowerment.

The aim of the study was to examine if there were differences between scores of internalized stigma and empowerment in relation to socio-demographic characteristics (gender, age, education level, marital status, living arrangement, employment status) of participants in a sample of people with physical disabilities.

METHOD

The sample

Participants were 119 adult persons, aged between 18 to 70 years (M = 35.68; SD = 14.63), with different disorders of the musculoskeletal system (spinal cord injury, muscular dystrophy, multiple sclerosis, amputation, orthopedic cases, cerebral palsy; see Milačić Vidojević et al., 2020 for more details). Table 1 shows the socio-demographic characteristics of the sample.

Table 1. *Socio-demographic characteristics of sample (N = 119)*

		Frequency	Percent
gender	male	59	49.6
	female	60	50.4
education	primary	19	16.0
	secondary	78	65.5
	higher	22	18.5
employment	unemployed	43	36.1
	student	20	16.8
	employed	31	26.1
	retired	25	21.0
marital status	single	75	63.0
	married	35	29.4
	divorced	4	3.4
	widowed	5	4.2

Instruments

In the study two scales were administrated: revised *Internalized Stigma of Mental Illness Scale* (ISMI) and *Boston University Empowerment Scale* (BUES). With regard to aim of the present study, ISMI was adapted using term “physical disability” instead of “mental illness”. Other studies also revised ISMI in accordance with their sample, such as epilepsy, leprosy, etc. (see Milačić Vidojević, Čolić, Tošković, & Dragojević, 2020). The BUES was translated in Serbian language and back translated to English, while we applied Serbian version of ISMI (Milačić Vidojević, Dragojević, Tošković, & Popović, 2014).

Internalized stigma was assessed using revised *Internalized Stigma of Mental Illness Scale* (Ritsher, Otilingam, & Grajales, 2003). ISMI consists of the following five subscales: a) *Alienation* (6 items) that measures a personal experiences of feeling as not being equal member of society b) *Stereotype Endorsement* (7 items) which examines the degree with which a person agrees and accepts stereotype about disability, c) *Perceived Discrimination* (5 items) explores perception of the individual in relation to other people discriminate persons with disabilities, d) *Social Withdrawal* (6 items) measures degree of social withdrawal, and e) *Resistance* (5 items) explores resistance to stigma internalization . It is a 4-degree Likert-type scale, with four degrees of accepting the item, ranging from not agree at all (score 1) to agree completely (score 4). Higher score points to higher degree of stigmatization. Ritsher, Otilingam, and Grajales (2003) found strong internal consistency (α = 0.90) and high test-retest reliability (r = 0.92).

Subjective feelings of empowerment were assessed using *Boston University Empowerment Scale* (Rogers, Chamberlin, Ellison, & Crean, 1997). BUES contains 28 items measured on a 4-point Likert scale ranging from “strongly agree” to “strongly disagree”. The items are grouped into five subscales: *righteous anger, optimism and control over the future, self-esteem-self-efficacy, perceived power-powerlessness, and community activism and autonomy.* Higher scores represent a lower capacity of making decisions and lower levels of self-esteem/self-efficacy and power. The scale has demonstrated good consistency and internal reliability, factorial validity and known-groups validity. The scale had high internal consistency with Cronbach alpha 0.86 and 0.82, and good factorial validity (Rogers et al., 1997).

Data analysis

Pearson correlation coefficients, One-way analysis of variance (ANOVA), Scheffe post hoc test, and t- test for independent samples were applied in analyzing the data.

Procedure

The fourth semester students of the Faculty of Special Education and Rehabilitation at University of Belgrade were trained to conduct an interview and administrate the ISMI and the BUES. The organizations of people with different types of physical disabilities in Serbia were contacted and invited to participate in the study. The participants were recruited through the organizations which agreed to participate. Interviews were conducted in a private room with participant. The participants were informed that their responses would be kept confidential and they could terminate the participation in the study at any moment without negative implications for care received. The testing procedure lasted 30–45 minutes. Local requirements for ethical approval of the study were met. The participants provided oral consent for taking part in the study.

RESULTS

In the *Internalized Stigma of Mental Illness Scale* (M = 2.06; SD = 0.47), the highest mean value was observed in the *Resistance* subscale (M = 2.83), and the lowest in the *Endorsement* subscale (M = 1.70). According to the results found in participants with physical disabilities in the *Boston University Empowerment Scale*, the highest arithmetical mean was noticed in the *Power* subscale (M = 1.70), followed by the subscales *Self-esteem* (M = 18.52), *Community* (M = 10.62), *Anger* (M = 9.32) and *Optimism* (M = 8.47).

Socio-demographic correlates of stigma

The independent sample *t* test didn't reveal any significant difference between genders on stigma and empowerment scores.

The independent sample *t*-test showed that unmarried participants had higher scores on internalized stigma *perceived discrimination subscale* ($t = 1.995$, $df = 117$, $p < 0.05$), than married participants. Further, we established that participants who did not live in their own apartment reported higher level of *alienation* ($t = -2.696$, $df = 117$, $p < 0.01$), *perceived discrimination* ($t = -3.475$, $df = 117$, $p < 0.01$), *withdrawal* ($t = -3.205$, $df = 117$, $p < 0.01$) (Figure 1), as well as lower level of empowerment subscale *community* ($t = -3.627$, $df = 117$, $p < 0.01$) and *power* ($t = -2.656$, $df = 117$, $p < 0.01$) (Figure 2), than participants who had lived in their own apartment (Figure 1).

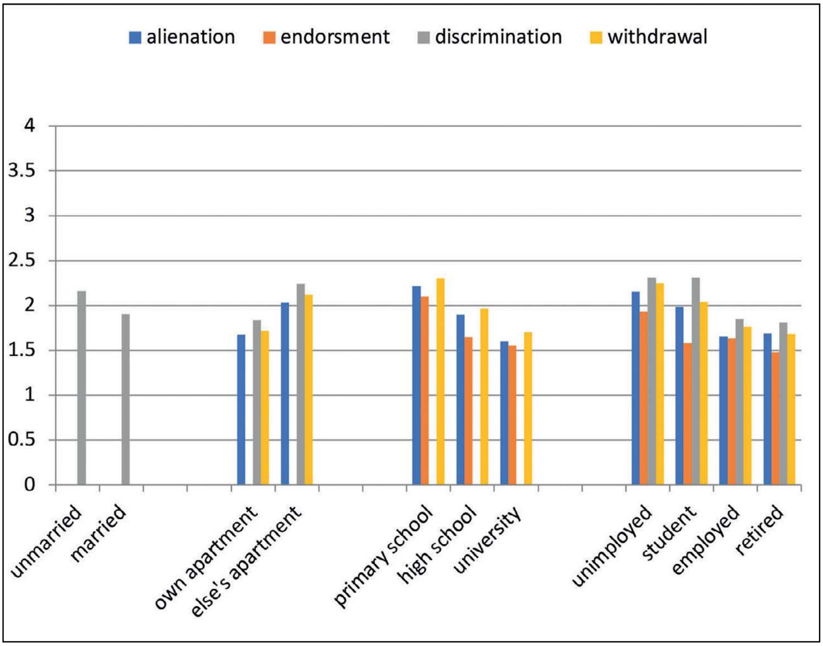

Figure 1. Internalized stigma scores in relation to socio-demographic variables

One-way analysis of variance (ANOVA) on the level of education was conducted for each of stigma subscales. Results indicated that the level of education was associated with *alienation* ($F(2,116) = 4.197$, $p < 0.05$), *endorsement* ($F(2,116) = 6.064$, $p < 0.01$) and *withdrawal* ($F(2,116) = 4.165$, $p < 0.05$) subscales of internalized stigma (Figure 1). Also, level of education was related to empowerment *self-esteem* ($F(2,116) = 5.204$, $p < 0.01$) and *optimism* subscale ($F(2,116) = 3.339$, $p < 0.05$) (Figure 2). Participants with a lower education levels showed higher degree of internalized stigma alienation, endorsement and withdrawal, as well as lower level of empowerment self- esteem and optimism.

In addition, ANOVA was conducted to examine relation of current professional level (student, unemployed, employed and retired) for stigma subscales separately for each factor. Analyses showed that the professional level was related to *alienation* ($F(3,115) = 4.307$, $p < 0.01$), *endorsement* ($F(3,115) = 4.314$, $p < 0.01$), *discrimination* ($F(3,115) = 6.235$, $p < 0.01$) and *withdrawal* ($F(3,115) = 5.361$, $p < 0.01$) subscales of internalized stigma (Figure 1). Also, professional level was related to empowerment *self-esteem* ($F(3,115) = 3.226$, $p < .05$), *community* ($F(3,115) = 9.703$, $p < 0.01$) and *optimism* subscales ($F(3,115) = 3.768$, $p < 0.05$) (Figure 2). Scheffe's post-hoc tests revealed that participants who were unemployed reported a higher level of alienation than participants who were employed, and a higher level of endorsement than retired participants. Analyses also indicated that participants who were unemployed experienced more withdrawal from society and overall internalized stigma than both participants who were employed and retired participants. As for empowerment scales, results showed that unemployed participants experienced less self-esteem than students, and less belief in community than retired participants (Figure 2).

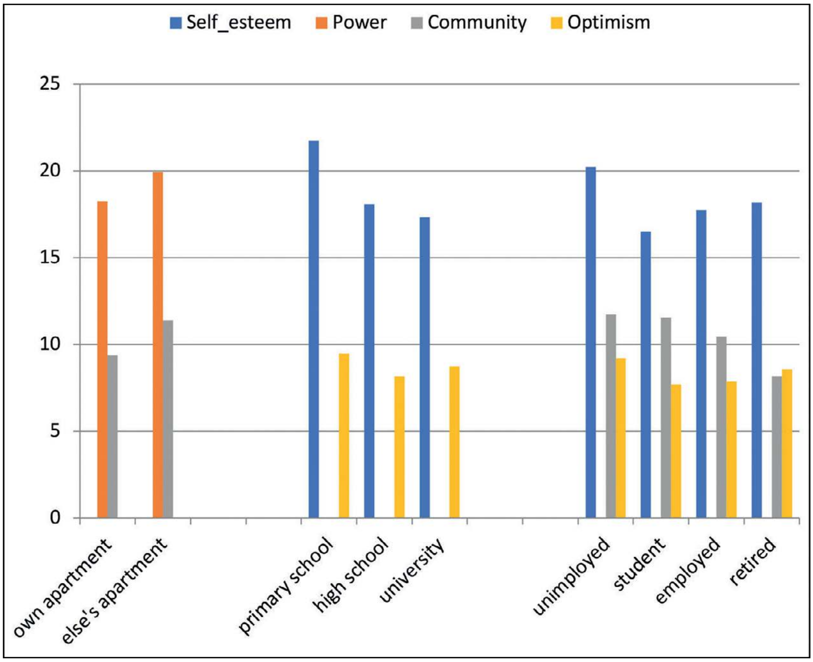

Figure 2. Empowerment scores in relation to socio-demographic variables

Pearson correlation was used to examine the relationship between the age of participants and each subscale of internalized stigma scores and empowerment scores. Results revealed a negative relationship between age and *alienation* ($r = -0.201$, $p < 0.05$), *endorsement* ($r = -0.193$, $p < 0.05$), *discrimination* ($r = -0.301$, $p < 0.01$), *withdrawal* ($r = -0.275$, $p < 0.01$) on subscales of internalized stigma and empowerment *community subscale* ($r = -0.359$, $p < 0.00$). Younger participants felt having more alienation, endorsement, discrimination and withdrawal and less belief in community strength.

DISCUSSION

The study aimed to explore the relationship among the components of internalized stigma and empowerment and socio-demographic characteristics of adult people with physical disabilities.

As far as socio-demographic correlates of internalized stigma and empowerment are concerned, there were no differences neither in stigma nor in empowerment due to gender of participants. Unmarried compared to married participants had higher scores on ISMI subscale perceived discrimination. Social support due to marital status is found to be connected to lower *perceived discrimination* (Schulz & Decker, 1985).

Participants not living in their own apartments had higher scores on *alienation*, *perceived discrimination* and *social withdrawal* subscales of ISMI and lower levels on *community and power* subscales of BUES compared to participants living in their own apartments. The result is in accordance with results of other studies which established that the highest anticipated discrimination intensity was found in participants who lived in extended families, then in those who lived in primary families, and the lowest intensity was in those living alone (Milačić Vidojević, Tošković, Dragojević, & Čolić, 2017). In Serbia 94% of persons with physical disability live with family members. These persons would have to 100% participate in paying the service of living with support what is not a possible option considering low employment rate of target population (Dinkić, Ljubinković, Ognjenović, Rajkov, & Milojević, 2008).

In the study, participants of lower levels of education had higher scores on *alienation, endorsing stereotypes* and *social withdrawal* subscales of ISMI and lower scores on *self-esteem* and *optimism* subscales of BUES. Perhaps they have less efficient coping strategies and are less familiar with their rights and opportunities. A study conducted in Ethiopia revealed that with increasing levels of education for people with schizophrenia internalized stigma was lower (Assefa, Shibre, Asher, & Fekadu, 2012). Similar results were found among people with mental illness in Europe (Brohan et al., 2010). Also, it was established that carrying out fulfilling activities strengthen the sense of meaning (Viemero & Krause, 1998). Herth established that more educated participants of general population obtained higher scores on Hope scale (Herth, 1992). The more educated persons more easily see the ways to achieve positive goals in the future and more easily notice the provided opportunities. In accordance is the result of the study that more educated participants expressed stronger capacity for problem solving (Langelaan, 2007).

Unemployed compared to employed participants had higher general score on ISMI scale as well as higher scores on *alienation, endorsing stereotypes, perceived discrimination and social withdrawal* subscales of ISMI. Unemployed compared to retired participants obtained higher general score on ISMI scale as well as higher scores on *endorsing stereotypes* subscale of ISMI and lower scores on *community* subscales of BUES. Also, they have lower levels of *self-esteem and optimism* subscales of BUES compared to students. Unemployment leads to feelings of alienation and marginalization (Milačić-Vidojević, Jovanović, & Brojčin, 2010), which is an additional burden for persons with disabilities. Persons with disabilities may experience discrimination in looking for a job or keeping a job. Unemployment can have serious negative effect on the lives of disabled persons, such as financial and psychological stress, feelings of frustration and being constrained to live on state benefits. Employment status appeared to be important for social identity and feeling of self-esteem of persons suffering from schizophrenia. Unemployed participants felt isolated and marginalized (Milačić-Vidojević et al., 2010). Satisfaction with life situation in persons with physical disability is connected to the profession or meaningful activities, to social integration, to sense of life meaning (Viemero & Krause, 1998), and to increased independence (Fleming, Fairweather, & Leahy, 2013). These studies confirm that engagement in purposeful activity supports satisfaction with various life domains.

There is no systematically processed data related to the employment level of people with disabilities available in Serbia. In developed EU countries the employment level of adults with disabilities is around 50%, whereas in some other countries, i.e. Poland, it's less than half (Łukomska, 2008). Moreover, according to some studies, most employers in Poland hardly even consider the possibility of hiring persons with disabilities, primarily due to the stereotypes linking disabilities with a lack of independence, skills, potential and ambition (Kowalik, 2007).

Younger participants had higher scores on *alienation, endorsing stereotypes, perceived discrimination and social withdrawal* subscales of ISMI and lower scores on *community* subscale of BUES compared to older ones. Younger participants have higher life expectations in terms of performing developmental tasks, which is difficult to achieve due to disabilities. These results are in line with the studies which showed a negative relationship between age and internalized stigma (Livingston & Boyd, 2010) but not in accordance with the study which showed positive association (Krajewski, Burazeri, & Brand, 2013). An additional research is necessary. The experiences of discrimination are more evident at young age which leads to self-stigmatization. Young people have less experience of believing in the community, they have not yet been able to empower themselves.

Examining intensity of anticipated discrimination in persons with physical disabilities it was established that discrimination is more anticipated by unmarried participants, younger, participants living in extended families and by participants not living in their own apartments (Milačić Vidojević, Tošković, Dragojević, & Čolić, 2017), the results in accordance with findings about internalized stigma and empowerment in target population.

Most persons with disabilities are fully aware of their exposure to this stigma, which adversely affects their self-esteem and general disposition, increases sensitivity to stressful events, impairs communication, lowers aspiration levels, diminishes possibility of receiving social support, and generally lowers their quality of life (Abraham et al., 2002; Cooney et al., 2006; Jahoda et al., 2010; Paterson, McKenzie, & Lindsay, 2012), including issues in finding and keeping employment. As a consequence of a series of intertwined external and internal barriers, belonging to the "disabled" category often becomes the person's primary identity and overshadows all other identities such as religious, ethnical or gender (Beart, Hardy, & Buchan, 2005). Family members are often exposed to the stigma as well, particularly parents, which deepens the social exclusion of both the person with a disability and their family, creating further difficulties in participating in social, cultural, economic and political life and isolating them from the community (Milačić Vidojević, Gligorović, & Dragojević, 2014; Munyi, 2012; Ouellette-Kuntz et al., 2009).

CONCLUSION

Socio-demographic variables appeared to have considerable importance for the understanding of internalized stigma and of empowerment in adult people with physical disabilities. It was revealed that higher levels of internalized stigma had unmarried, unemployed, younger, less educated participants, and participants who did not live in their own apartments.

Thus, in designing anti-stigma campaigns and programs for empowerment it is important to take into consideration specific socio-demographic characteristics of the targeted individuals. Specifically, anti-stigma and empowerment programs tailored for Serbian people with physical disabilities should be aimed at unmarried, unemployed, younger, less educated participants, and participants who do not live in their own apartments.

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ACOUSTIC ANALYSIS OF VOICE AND SPEECH IN ADULTS WITH SPASTIC DYSARTHRIA

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SUMMARY

Spastic dysarthria as a motor speech disorder impairs the intelligibility of speech production. By perceptual evaluation in individuals with this type of dysarthria, disorders of articulation, tense phonation, impaired prosody and nasalization, monotonous production and slow and difficult speech are observed. Acoustic analysis can provide quantitative data on the deviation of speech and voice characteristics of individuals with dysarthria compared to typical speakers.

The goal of this research was to determine the values of acoustic parameters of voice and speech in adults with spastic dysarthria compared to those values in typical speakers. The analysis was performed by using the Multidimensional Voice Program (MDVP) based on continuous phonation of vowel /a/ and speech patterns obtained by reading Balanced Text. The sample consisted of 36 individuals with spastic dysarthria, of whom 20 (55.6%) were men and 16 (44.4%) were women, aged 22 to 87 (M = 61.7).

The results showed that the majority of the twelve acoustic voice parameters tested in individuals with spastic dysarthria showed statistically significant deviation from the norms applicable to typical speakers. The acoustic parameters examined included those indicating variability of fundamental frequency, variability of amplitude, presence of noise, irregularities and interruptions in voice. Also, spectral analysis indicated statistically significant deviations in the position of the formants of vowels /e/ and /i/, as well as the occurence of centralization of the vowel formants, which together indicate impaired intelligibility of speech production.

Acoustic analysis of speech of individuals with spastic dysarthria provided data indicating a serious pathology of their voice and speech. Such data are very useful because they make it easy to determine the appropriate treatment, managing the patient during the treatment, and also conducting the evaluation of the treatment.

Key words: acoustic analysis, spastic dysarthria, speech, voice

INTRODUCTION

Spastic dysarthria is a motor speech disorder that results from damage to the upper motor neuron whose function is to convey impulses from the motor areas of the cortex to the lower motor neuron. It occurs within cerebral palsy and as a result of traumatic brain damage, with increased tone (spasticity or hypertonus), weakness or decreased range of voluntary limb muscle movements and the orofacial region (Kent, Duffy, Straw, Kent, & Clift, 2001). Other authors state that spastic dysarthria most commonly occurs in pseudobulbar palsy and spastic hemiplegia (Murdoch, 2014). This type of dysarthria is considered to be one of the most common in both children and adults.

Spastic dysarthria can be of different severity, with difficulty in accomplishing the process of respiration, phonation, and articulation. It is typically characterized by tense phonation, imprecise articulator placement (especially when uttering consonants), and reduction of temporal differences between speech and non-speech pauses (Hasegawa-Johnson, Gunderson, Perlman, & Huang, 2006). Speech production is further characterized by impaired prosody, prominent nasalization, and variations in speech rate, which impairs the intelligibility of speech production (Paja & Falk, 2012). Speech has been found to be generally slow and difficult (Griffiths & Bough, Jr., 1989).

Articulatory imprecision is one of the primary characteristics of this speech disorder (Marchant, McAuliffe, & Huckabee, 2008) and it occurs due to inadequate tongue and lip movements. Clark et al., (2014) noted that the following characteristics of speech were distinguished in patients with spastic dysarthria: tense voice quality, slow speech, without pitch and loudness modulation (monotonous speech), hypernasality, and speech in short phrases. Rough and strained voice quality is caused by increased vocal fold tension (hyperadduction) that occurs in people with spastic dysarthria.

Dysarthria caused by pseudobulbar palsy results in strained and rough voice, hypernasality, impaired articulation with imprecise voice production, and abrupt interruptions of phonation (Murdoch, Ward, & Theodoros, 2008), whereas in those caused by spastic hemiplegia, a milder speech disorder occurs with articulation that is slow and imprecise as the most affected (Murdoch, 2014). Bilateral damage to the upper motor neuron, either at the cortical or subcortical level, leads to syndromes typical of spastic dysarthria. Slow articulatory movements with reduced amplitude occur as well as hypernasality due to lack of adequate velum lift, tongue retraction, pharynx narrowing, and hyperadduction of shortened vocal folds (Ziegler & von Cramon, 1986). In extreme cases, complete anarthria or aphonia can occur (Ackermann, Hertrich, & Ziegler, 2010).

Acoustic analysis of voice and speech in people with dysarthria

Acoustic analysis of speech and voice is performed on the basis of continuous phonation of vowels or spontaneous speech samples on the basis of which spectrographic analysis is performed. With the help of special computer programs, the values of acoustic parameters of voice and speech are obtained as objective indicators of possible pathology of voice. Computer-based devices that enable acoustic voice processing facilitate accurate diagnosis of voice disorders, follow-up on clinical work, and reduce the degree of subjectivity that occurs during perceptual assessment (Teixeira, Ferreira, & Carneiro, 2011).

Today, acoustic analysis of voice and speech is increasingly conducted in people with dysarthria, although it is noted that not all types of dysarthria are equally represented in research (Arsenić, 2019). Dysarthria is known to be a speech disorder that results in impaired speech control mechanisms and occurs as a consequence of damage to the central or peripheral nervous system (Darley, Aronson, & Brown, 1969). The neurological dysphonias that occur within dysarthria are very important in differential diagnosis. In cases where laryngeal function is impaired as a result of neurological dysfunction, other speech components are impaired. Vowel analysis in individuals with neurological diseases can significantly contribute to early diagnosis, differential diagnosis, and monitoring of disease progression (Abberton, 2005). It allows quantification of data and a description of the correlation of perceptual assessment of speech intelligibility, quality of voice, and type of dysarthria (Carrillo & Ortiz, 2007). The basic goals of acoustic analysis are to contribute to the proper diagnosis of neurological diseases of different neurological subsystems, to identify progressive degeneration of neurological disease and to identify subclinical manifestations of neurological disease (Amir, Dukas, & Schnaps-Baum, 2005; Deliyski, Evans, & Shaw, 2005). Also today, more attention is directed towards what impact have characteristics of voice and speech in dysarthria on individuals, their feelings related to problems during the conversation and their interaction with other people and the quality of their communication (Arsenić & Jovanović Simić 2019; Arsenić, Jovanović Simić, Petrović Lazić, Šehović, & Drljan, 2019; Jovanović Simić, Arsenić, Drljan, & Milovanović, 2019).

Computer programs for voice analysis provides for more detailed and clearer description and clarification of the various voice dysfunctions in the context of speech disorders (Arsenić et al., 2019; Arsenić, Jovanović Simić, Petrović Lazić, & Šehović, 2019). One of the programs which has a clinical and research application in voice assessment in people with dysarthria is the multi-parameter acoustic voice analysis or the Multidimensional Voice Program (MDVP program by Kay Elemetrics Corporation). The program provides fast and standardized voice assessment and displays 33 acoustic parameters of the processed voice and provides a view of the analysed speech pattern in the form of a spectrogram. The obtained parameter values are compared with the reference values contained in the program, which are obtained on the basis of voice and speech analysis of typical speakers of a particular language. In analysing the data, care must be taken that there are reference values separately for men and women. In addition, the program also allows the installation of alternative normative values, for example for the elderly or children.

Acoustic voice parameters that can be obtained using a computer program for multidimensional analysis are most often divided into four groups: parameters indicating variability of voice frequency, parameters indicating variability of voice amplitude, parameters indicating interruptions in voice, presence of subharmonics, and irregularities in the voice and parameters indicating the presence of noise and tremors in the voice (Deliyski & Gress, 1998). However, this is not the only division of acoustic voice parameters. Depending on the measurement goals, there are different categorizations of MDVP parameters. Other authors (Lierde et al., 1996, according to Kent, Vorperian, Kent, & Duffy, 2003) represent eight groups of acoustic voice parameters: fundamental frequency parameters, frequency perturbation parameters, amplitude parameters, voice irregularity parameters, tremor analysis parameters, voice interruption parameters, subharmonic parameters and noise parameters.

MDVP also enables acoustic analysis of the speech signal in individuals with dysarthria, where the signal is presented through a spectrogram. It is a visual presentation of an acoustic signal in three dimensions: time, frequency and amplitude (Sovilj-Nikić, 2014). The acoustic structure of the voices of the Serbian language has three aspects: formant, noise and combined formant - noise. The formant of acoustic energy is characteristic for vowels, formant-noise form for nasals and laterals, while the noise form is related to plosives, fricatives and affricates. The first three acoustic energy concentrates for each voice individually are the most important for auditory voice discrimination. The values of formats of all voices are the same for men and women and do not depend on the height of the basic laryngeal tone.

The goal of the research was to determine the acoustic characteristics of voice and speech in adults with spastic dysarthria. It was examined whether the values of the acoustic parameters of the voice and the values of the vowel formants significantly deviate from the norms applicable to typical speakers of Serbian.

METHOD

The sample consisted of 36 individuals with spastic dysarthria, of whom 20 (55.6%) were men and 16 (44.4%) were women, aged 22 to 87 (M = 61.7). The respondents native language was Serbian and they did not have associated disabilities that could affect speech and voice characteristics.

The research was conducted at the Rehabilitation Clinic "Dr Miroslav Zotović" and the Special Hospital for Cerebrovascular Diseases "St. Sava" in Belgrade, while the data were processed and analysed at the Clinical-Hospital Center "Zvezdara" in Belgrade. The test was conducted individually, in a quiet room, isolated from noise. Voice and speech were recorded with a voice recorder at a distance of 5 cm from the mouth.

The instruments used in the research are:

1. *The computerized speech laboratory for acoustic analysis of voice and speech of "Kay Elemetrics" corporations, model 4300* – by using the program for multidimensional voice analysis (MDVP), the values of 12 acoustic parameters were determined based on the continuous phonation of vowell /a/. The respondents were tasked with producing this vowel at the usual volume and height for 3 to 5 seconds. As the acoustic characteristics of the male and female voice differ, the analysis was conducted separately for both sexes.

2. *Balanced Text (Šešum, 2013)* - Spectral analysis of vowels was performed with the help of multidimensional voice analysis software. Five vowels in the Serbian language were analyzed on the basis of a speech sample obtained by respondents reading "Balanced Text", which was specifically designed for the speech analysis. The text itself is a coherent semantic whole and contains complex statements that are grateful for speech analysis. In the text, the representation of all voices is as uniform as in everyday speech. Spectral analysis determined the position of the first and second formants (F1, F2) for each vowel.

Out of 12 acoustic voice parameters, six indicate fundamental frequency variability (Fo, MFo, Fhi, Flo, Jita, Jitt), two parameters represented the variability of voice amplitude (ShdB, Shim), two the presence of noise in the voice (NHR, SPI), and two presence of irregularities and interruptions in the voice (DVB, DUV).

Parameters indicating fundamental frequency variability are: ***Fo*** - Average Fundamental Frequency /Hz/ corresponding to the number of vibratory vocal fold cycles per second (Carrillo & Ortiz, 2007). In addition to fundamental frequency there are ***MFo*** - Mean Fundamental Frequency /Hz/, ***Fhi*** - Highest Fundamental Frequency /Hz/ and ***Flo*** - Lowest Fundamental Frequency /Hz/. Increased *MFo* values indicate pathological conditions due to shortening of the vibratory zones of the vocal cords, increased stiffness of the mucosa, a decrease in the mass of the vocal cords, or an increase in subglottic pressure. Decreased values of the *MFo* parameter occur due to an increase in the mass of the vibrating structure or a decrease in laryngeal position (Deliyski & Gress, 1998).

The perturbation parameters of voice frequency (***Jitter***) and amplitude (***Shimmer***) are used to test speech intelligibility and are most commonly used when describing pathological voice. Both of these parameters can be determined using the relative values of ***Jitt*** /%/ and ***Shim*** /% / or absolute values of ***Jita*** /µs/ and ***ShdB*** /dB/ (Teixeira & Gonçalves, 2014).

NHR (Noise to Harmonic Ratio) is a parameter indicating the range between periodic (harmonic) and aperiodic (noise) components and most commonly indicates increased noise occurring at the glottis level (Buder, 2000), and the ***SPI*** (Soft Phonation Index) parameter is an indicator of how much the vocal cords close and tighten during phonation. An increased value of the *SPI* parameter is usually an indicator of insufficiently tightened and incompletely closed vocal cords during phonation (Deliyski & Gress, 1998).

DVB - Degree of Voice Breaks /%/ represents the ratio between the total duration of parts with interruptions in the voice and the duration of the complete voice sample, more precisely it represents the percentage of parts with interruptions in voice. ***DUV*** - Degree of Voiceless /%/ measures the voice's ability to last continuously. The normative threshold for both parameters is 0 (zero) because normal voice in certain voice maintenance tasks should not have any segments without voice or interruption of voice (Deliyski & Gress, 1998).

Statistical processing and analysis of data was performed in the statistical package SPSS 24. Frequencies, percentages and sample mean (arithmetic mean) were used as descriptive statistics measures. Standard deviation was used as a measure of deviation from the arithmetic mean. The probability level was set at $p < 0.05$. Differences of sample values with respect to norms were tested by t test for one sample.

RESULTS WITH DISCUSSION

Acoustic analysis of voice

Many authors (Heman-Ackah et al., 2003; Maryn, Roy, De Bodt, Van Cauwenberge, & Corthals, 2009; Teixeira & Fernandes, 2014) state that in the acoustic analysis of voice using MDVP, the attention is most commonly paid at the values of fundamental frequencies parameters (*Fo*), *NHR* parameter (noise-harmonic ratio), *jitter* and *shimmer* perturbation parameters, and the range of fundamental frequency. The *jitter*, *shimmer*, and *NHR* parameters are cited as the cornerstone of acoustic measures of voice signal and are most commonly regarded as indicators of perceived voice quality in both normal and pathological voice (Kreiman & Gerratt, 2005).

As expected, the values of a large number of acoustic voice parameters in individuals with spastic dysarthria differed from the norms applicable to typical speakers. Even most of the acoustic parameters were statistically significantly different (Table 1).

Table 1. *Average values of acoustic parameters and differences compared to normal values, male*

	Male		**t**	**df**	**p**
	M	**SD**			
Fo	153.611	35.229	1.064	19	0.301
MFo	140.196	21.488	-0.322	19	0.751
Fhi	297.227	164.570	3.999	19	***0.001***
Flo	96.982	24.152	-8.043	19	***0.000***
Jita	501.510	422.826	4.864	19	***0.000***
Jitt	7.026	5.952	4.837	19	***0.000***
ShdB	1.560	0.714	8.392	19	***0.000***
Shim	16.488	6.813	9.166	19	***0.000***
NHR	0.458	0.229	6.558	19	***0.000***
SPI	4.454	1.985	-5.217	19	***0.000***
DVB	10.835	19.050	2.497	19	***0.022***
DUV	47.729	33.120	6.418	19	***0.000***

M – arithmetic mean, SD-standard deviation, t – t test for one sample,
df – degrees of freedom, p – statistical significance

Table 1 shows that the voice of male individuals with spastic dysarthria is significantly altered compared to that of typical speakers. Most of the values of the acoustic parameters are statistically significantly different from the norms, except for the parameter *Fo* which is slightly higher and *MFo* which is slightly lower. Among the parameters that showed a statistically significant difference from the norms, *Flo* and *SPI* were lower, while all other parameters were statistically significantly higher than the norms applicable to typical male speakers.

Most of the acoustic parameters of the voice of women with spastic dysarthria are also statistically significantly different from the norms applicable to female speakers who are typical speakers (Table 2).

Table 2. *Average values of acoustic parameters and differences compared to normal values, female*

	Female		**t**	**df**	**p**
	M	**SD**			
Fo	169.900	56.324	-5.261	15	***0.000***
MFo	167.060	56.803	-5.212	15	***0.000***
Fhi	259.303	141.020	0.187	15	0.854
Flo	136.432	59.963	-6.566	15	***0.000***
Jita	353.740	448.538	2.914	15	***0.011***
Jitt	4.706	4.717	3.454	15	***0.004***
ShdB	1.356	1.024	4.609	15	***0.000***
Shim	13.583	9.404	4.928	15	***0.000***
NHR	0.414	0.309	3.907	15	***0.001***
SPI	4.841	1.394	-7.730	15	***0.000***
DVB	4.996	8.672	2.212	15	***0.043***
DUV	32.186	33.683	3.799	15	***0.002***

M – arithmetic mean, SD-standard deviation, t – t test for one sample,
df – degrees of freedom, p – statistical significance

There is no difference only on the parameter *Fhi* which is slightly higher than the norms. Among the parameters showing statistically significant difference, *Fo*, *MFo*, *Flo* and *SPI* have lower values compared to the norms, while the values of all remaining parameters are higher.

It can be seen that the values of the *Flo* and *SPI* acoustic parameters are statistically significantly lower than the norms for both sexes, while most of the remaining parameters for both respondents are statistically significantly higher than the standards existing for typical speakers. An increased value of the *SPI* parameter is usually an indicator of insufficiently tightened and incompletely closed vocal cords during phonation. Still, it does not have to indicate a voice disorder. Similarly, patients with inadequate phonation may have a "normal" value of this parameter, although such a voice characteristic may be undesirable. Therefore, the high value of this parameter does not have to be bad, nor does the low value of the *SPI* parameter need to be good (Deliyski & Gress, 1998).

As in many previous researches with all types of dysarthria, our research showed in individuals with spastic dysarthria that the values of the *jitter* and *shimmer* parameters were always increased. These values are known to be elevated in neurogenic dysphonias because they indicate irregularity of vocal cords vibration as a result of reduced neuromuscular control of laryngeal abductors and adductors (Carrillo & Ortiz, 2007). Fundamental frequency values in respondents with dysarthria are characterized by an excessive amount of *jitter* voice acoustic parameter (Kain, Niu, Hosom, Miao, & Santen, 2004), and the fundamental frequency range is narrower than in the control group respondents (Mori, Kobayashi, Kasuya, Hirose, & Kobayashi, 2004).

Increased *NHR* parameter values also found in the sample of respondents with spastic dysarthria are interpreted as increased spectral noise, which may be caused by variations in amplitude and frequency, presence of turbulent noise, subharmonic components or interruptions in voice, all of which indicate pathology of voice and impaired speech intelligibility. The noise present in the spoken vowel spectrum gives the voice a specific colour, that is, roughness if present to a greater extent and degrades the quality of the vowel (Antić, Šagovnović, & Popović, 1997).

The *DVB* and *DUV* parameters are statistically significantly higher than the norms. Such results indicate that a large number of interruptions in the voice as well as periods without voice occur in individuals with spastic dysarthria, which indicates a very difficult speech of these persons as well as impaired intelligibility of speech production.

More recent research (Giri & Rayavarapu, 2018) examined the values of the acoustic parameter *MFo* for individuals with dysarthria of flaccid, spastic and hypokinetic type. The acoustic characteristics of individuals with and without dysarthria, men and women separately, were compared. A male respondent with spastic dysarthria achieved an *MFo* value of about 156 Hz, which is higher than that in typical male speakers. In our research, the average values of the *MFo* parameter were slightly lower (without statistical significance) in a sample of 36 respondents. It is important to note that the main drawback of the research is that it was performed on one respondent in each type of dysarthria.

In another research (Mori et al., 2004), the values of the acoustic parameters of the voice of respondents with different types of dysarthria were compared. Sixteen male patients were examined, of whom 5 were respondents with pseudobulbar palsy (spastic dysarthria), 7 with Parkinson's disease (hypokinetic dysarthria) and 4 with ALS (spastic-flaccid dysarthria). The sample was compared with six male individuals from the control group. The research examined the fundamental frequency of voice (*Fo*) as well as the minimum of fundamental frequency (*Flo*). The results showed that the *Fo* range in respondents with dysarthria was narrower than that in the control group, indicating that their intonation pattern was flattened. A flattened intonation pattern is observed to be a general characteristic of dysarthria while fundamental frequency values differ among types of dysarthria. In individuals with spastic-flaccid dysarthria due to muscular weakness, the tension in the vocal folds is reduced, resulting in lower levels of *Fo*. In individuals with spastic dysarthria, the values of fundamental frequencies are different depending on whether there is hypertension or hypotension of the vocal cords (Mori et al., 2004). Thus, in our research, in the male respondents, the values of the *Fo* parameter were on average slightly higher than typical male speakers, while the values of this parameter were statistically significantly lower in the female respondents than in the typical female speakers.

Another research (Dogan, Midi, Yazıcı, Kocak, Günal, & Sehitoglu, 2007) examined the speech of 27 female patients with dysarthria suffering from multiple sclerosis. Patients with multiple sclerosis most often have spastic and ataxic dysarthria. Changes in voice in these individuals are characterized by impairment of voice control and the presence of roughness in the voice. Less common problems are impaired voice control, inadequate voice height, shortness of breath, and hypernasality. The computer voice analysis (MDVP) was used to evaluate the vowel /a/ to obtain the values of acoustic parameters: *Jitt*, *Shim*, *SPI*, *NHR* and *MFo*. The acoustic parameters of *Jitt*, *Shim* and *SPI* were higher in female respondents with multiple sclerosis compared with female respondents in the control group. The *NHR* and *MFo* values were similar in dysarthria patients and control group. Most patients with multiple sclerosis had dysphonic speech that was due to weakness of voice. These patients tend to be aggravated by the following acoustic parameters: *Fo*, *SPI* and jitter. These results are consistent with the asthenic voice quality that occurs in individuals with multiple sclerosis. In our research, although there was no sample of respondents with multiple sclerosis, the results of the indicated values of acoustic parameters can be compared to the results on the sample of respondents with spastic dysarthria. As in the aforementioned research, in ours, the values of the *Jitt* and *Shim* parameters were statistically significantly higher than the norms applicable to women, while the value of the *SPI* parameter was lower than the norms, indicating a partial overlapping of the results.

Spectral analysis of vowels

Acoustic processing is also performed on the sample of spontaneous speech of respondents or their speech during reading (Buder, 2000). Spectral analysis usually determines the positions (frequency) of the first and second formants for all vowels or noise concentrate for some consonants. Spectral analysis can objectively determine the voice quality and describe the texture of phonation.

In this research, the position of the first two formants of all five vowels in the Serbian language in adults with spastic dysarthria was examined. The position of the first two formants determines the intelligibility of individual voices, and therefore the intelligibility of spoken production.

Table 3 shows the obtained values of the first and second formants of five Serbian vowels for persons with spastic dysarthria. The differences between the values achieved on the sample and the norms applicable to typical speakers were also examined. Differences were tested by t test for one sample.

Table 3. *Average values of formants and differences compared to normal values*

		N	**Min**	**Max**	**M**	**SD**	**t**	**df**	**p**
A	**F1**	36	448.000	842.000	658.972	110.453	0.487	35	0.629
	F2	36	926.000	1614.000	1301.944	172.176	-0.106	35	0.916
E	**F1**	36	418.000	662.000	514.028	77.365	-0.075	35	0.940
	F2	36	1016.000	2332.000	1636.250	335.994	18.505	35	***0.000***
I	**F1**	36	179.000	807.000	381.333	120.703	4.043	35	***0.000***
	F2	36	896.000	2601.000	1892.889	546.275	-2.275	35	***0.029***
O	**F1**	36	328.000	687.000	510.917	84.632	-0.077	35	0.939
	F2	36	747.000	1204.000	994.250	119.517	-0.038	35	0.970
U	**F1**	35	180.000	687.000	379.171	116.857	0.161	34	0.873
	F2	35	508.000	1315.000	843.371	180.732	1.420	34	0.165

N - number of respondents, Min - minimum value on the sample, Max – maximum value on the sample,
M – arithmetic mean, SD-standard deviation, t – t-test, df – degrees of freedom, p – statistical significance

A statistically significant difference between sample values and norms was determined for the first and second formant (F1, F2) of vowel /i/ ($p < 0.001$; $p < 0.05$) and the second formant (F2) of vowel / e/ ($p < 0.001$).

F1 values of vowel /i/ in typical speakers range between 170 and 300 Hz, and the average sample value obtained is higher and it is M = 381,333 Hz. The second formant (F2) of vowel /i/ has a normal value of 2100 to 2500 Hz, and the achieved value on the sample of people with spastic dysarthria is lower than the norm and it is M = 1892,889 Hz. F2 value of vowel /e/ in typical speakers ranges from 1720-2000 Hz, while the sample values are lower (M = 1636,250). Based on the above stated results, it can be observed that in persons with spastic dysarthria the centralization of the vowel formats was confirmed.

The results of our research showed that production of vowels in respondents with spastic dysarthria was characterized by centralization of the formant frequency and reduction of vowel range. Kent et al., (Kent, Vorperian, & Duffy, 1999) cite the same data indicating this specificity in the speech of individuals with dysarthria and state that reduced vowel space in dysarthria has a negative effect on intelligibility. Reduced vowel space which results from the increase of the otherwise low frequencies of the formats and the decrease of the otherwise high frequencies of the formats. Such changes in formant position are thought to be due to limited articulator movements, especially the tongue and jaw (Skodda, Grönheit, & Schlegel, 2012). Individuals with dysarthria make mistakes while articulating vowels and consonants. Also, in their speech there is often a pronounced nasality and prolongation of segments. All of the above stated disturbs the patterns of speech accentuation and causes the speech of people with dysarthria to be extremely slow and difficult (Duffy, 2005).

The "formant centralization ratio" measure is cited in a paper that examined the difference in speech between that of individuals with dysarthria and typical speakers (Sapir, Ramig, Spielman, & Fox, 2010). These authors argue that the measure clearly distinguishes between these two groups of persons, and that it represents a sensitive, valid and reliable acoustic measure for monitoring the effects of treatment. Although these results were obtained from a sample of individuals with hypokinetic dysarthria, the authors state that they can be applied to dysarthria resulting from multiple sclerosis, amyotrophic lateral sclerosis, cerebral palsy and traumatic brain damage. Most commonly, the first two formants (F1 and F2) are used for acoustic assessment of vowel production and perception (Hillenbrand, Getty, Clark, & Wheeler, 1995). The centralization of vowel formants is thought to be due to irregular movements of the articulators during their production. The range of articulatory movements has been reduced, so formants that otherwise have a lower frequency become higher and higher formants become lower. Such centralization can be represented through the vowel space area, i.e. the space between the first and the second formant. The greater the centralization, the smaller the vowel space.

Also, a study examining the speech of individuals with mixed dysarthria and dysarthria due to traumatic brain damage (Toshniwal & Joshi, 2010) examined the space area (between F1 and F2) for four vowels. It was found that in individuals with dysarthria due to traumatic brain damage, the vowel space area was reduced (F1 and F2) compared to respondents in the control group. Such reduced vowel space area indicates the presence of deviation in the exercise of articulatory movements in individual with traumatic brain damage.

A more recent study (Fougeron & Audibert, 2011) examined the acoustic characteristics of the voice of respondents with amyotrophic lateral sclerosis diagnosed with a mixed dysarthria (spastic-flaccid). This type of dysarthria is thought to have the greatest damage to the vowels compared to all other types. Abnormal frequency of the first and second formants (F1 and F2), reduced formant transition and reduced vowel space area were found to be present in ALS (Turner & Tjaden, 2000). The study examined 27 patients with ALS. It turned out that in male individuals, the more severe the degree of dysarthria and the incomprehensible speech, the smaller the vowel space area and the greater the overlap in the F2 position for the vowels /e/ and /o/. Also, in female individuals, the less comprehensible the speech, the smaller the vowel space area was, with the centralization of the vowels. When the male individuals with mixed dysarthria were compared with the control group of the respondents, it was found that there was a significant difference between the two groups in almost all the aspects related to the position of the formant. Male individuals with dysarthria had significantly smaller vowel space area, greater formalization of formats, reduced range of first and second formants (F1 and F2), and much more overlap in vowel pairs in first and second formants. There was only one statistically significant difference in women with dysarthria compared to those in the control group, i.e. there was significantly more overlapping in the F2 position in women with dysarthria, and that for middle vowels compared to the control group. The authors state that although altered vowels can be good predictors of speech intelligibility, they are not the only predictors.

Speech of individuals with dysarthria resulting from amyotrophic lateral sclerosis was analysed in a study by Horwitz et al (Horwitz-Martin et al., 2016). It was examined what acoustic parameters could indicate a loss of speech intelligibility and a decrease in speech rate in these respondents. The sample consisted of 34 people with ALS (16 men and 18 women). The results showed that there was a correlation between F1 and F2 on the one hand and the speed and intelligibility of speech on the other. Speech rate has been found to decrease over time in people with ALS and speech becomes more incomprehensible, which is associated with the frequency of formats (Horwitz-Martin et al., 2016). The dysarthria resulting from amyotrophic lateral sclerosis is also thought to be particularly reduced in the path (position) of the second formant (F2) (Weismer, Martin, Kent, & Kent, 1992).

Inadequate articulation of vowels is a common occurrence in all types of dysarthria, which result in large variations in the frequencies of formats, as well as in the centralization of formats. Changes in vowel space area, shallower vowel gradients, and variability in vowel transition also occur (Caballero-Morales, 2013). Given that the production of consonants requires much finer and more precise movements, this group of voices is even more damaged in individuals with dysarthria, and especially those involving friction. In these individuals, the height and volume of the voice are most often reduced, whereby acoustic parameters such as the fundamental frequency, duration, amplitude and quality of parts of the statement are impaired.

In the previously mentioned study (Giri & Rayavarapu, 2018), the position of the first three formants of the vowel /a/ in individuals with dysarthria of flaccid, spastic and hypokinetic type was examined in addition to the value of the acoustic parameter of the voice *MFo*. In male respondents with spastic dysarthria, male respondents with hypokinetic dysarthria, and female respondents with flaccid dysarthria, the values of the first three formats were slightly higher compared to typical speakers.

As it was found that there was a relationship between the position of the second formant of the vowel and the perceptual characteristics, we began to examine the influence of inadequate formant values on speech intelligibility in individuals with dysarthria. Thus, a significant correlation was found between F2 position for two vowels and sentence intelligibility in individuals with dysarthria resulting from amyotrophic lateral sclerosis (spastic or flacid dysarthria) and Parkinson's disease (hypokinetic dysarthria) (Weismer, Jeng, Laures, Kent, & Kent, 2001) and the link between the second formant and speech intelligibility in individuals with dysarthria as a consequence of Parkinson's disease and stroke (Kim, Weismer, Kent, & Duffy, 2009).

In people with dysarthria, it is stated that the range of fundamental frequency, the pitch of the second formant and the vowel space area contribute to the classification according to the severity of the speech disorder (Kim, Kent, & Weismer, 2011).

CONCLUSION

Acoustic analysis of voice and speech is a modern method of assessment, which is increasingly performed independently when diagnosing dysphonia and speech disorders of different types. Also, the application of computer programs in the analysis of voice and speech disorders is used as a complement to perceptual assessments that provide subjective data.

A review of the studies related to the acoustic analysis of voice and speech in individuals with dysarthria revealed that the majority were conducted in individuals with hypokinetic, ataxic and mixed dysarthria, while very few studies had a sample of people with spastic dysarthria. This data is unusual because it has been confirmed that spastic dysarthria is the most common among different types of dysarthria. Spastic dysarthria is characterized by slow and impaired speech due to spasticity or hypertonicity, which also affect the processes of respiration and phonation, as well as the reduced range of voluntary movements that impairs articulation. In addition, in individuals with spastic dysarthria, the prosody and intelligibility of speech production are severely impaired.

As shown in our research, by acoustic analysis of the voice of individuals with spastic dysarthria, results were obtained indicating statistically significant deviations of the values of acoustic parameters compared to norms. Such objective data facilitates the determination of adequate speech therapy, which may be directed to the rehabilitation of certain acoustic parameters of the voice. In addition, statistically significant variations in the position of the formats for some vowels were determined by spectral analysis of the voice. Difficulties in articulation are most noticeable in individuals with spastic dysarthria during the production of consonants, but as confirmed here, vowel articulation can also be problematic. Obtained objective data, which have been compared with the results of other studies, clearly indicate the nature and severity of voice and speech pathology in individuals with spastic dysarthria.

Thanks to acoustic analysis of voice and speech, which enables to obtain quantitative values of acoustic parameters of the voice and voice formants, it is possible to detect the pathology of the voice, possible changes in the vocal cords, early diagnostics, differential diagnosis, as well as clear and detailed determination of differences between the characteristics of normal and pathological voice (Teixeira & Fernandes, 2014). In addition, this type of analysis has many advantages as it facilitates to determine the appropriate treatment for each patient individually, evaluate the treatment, as well as to evaluate the improvement of voice and speech after the treatment.

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THE EFFECT OF FALLS AND OLDER AGE ON BALANCE PERFORMANCE AMONG ELDERLY POPULATION[a]

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SUMMARY

Falls and old age have negative effect on balance. Aim of research is to examine the effect of falls and older age on balance performance among elderly population. The sample comprised 142 individuals (52.8% men and 47.2% women) and the mean age for the participants was 73 years and 11 months (SD = 6 years and two months). To assess static and dynamic balance we use the total of twelve different balance test. Results show a statistically significant main effect of the variable related to fall when standing with feet partly put together, One Leg Stance ($p < 0.001$), 360 Degree Turn Test ($p < 0.05$) in mediolateral and anteroposterior direction. Significant main effect of age category on standing with the feet together eyes closed ($p < 0.05$) in anteroposterior direction and standing with feet partly put together, One Leg Stance ($p < 0.001$), Four Step Square Test, Time Up and Go Test – Motor/Cognitive ($p < 0.05$) in mediolateral and anteroposterior direction. Significant effect of the interaction of the factor of fall and the category of age when standing with the feet apart and eyes open ($p < 0.05$) in mediolateral direction, feet apart and eyes closed ($p < 0.05$) in anteroposterior direction, feet together and eyes closed in both directions. Conclusion of our study show that elderly people with a positive history of falling manifest significantly poorer balance on some balance tests compared to younger adults who did not experience a fall.

Key words: falls, old age, balance

INTRODUCTION

Today, 8.5% of the population is over 65 years old. By 2050, this number will increase to 17% (Wan, Goodkind, & Kowal, 2015), while in Europe the number of people over 65 will increase from 16% as measured in 2010 to 29.3% by 2060 (Creighton, 2014). Serbia is a country that follows that negative trend of demographic ageing, as well. According to the analysis of the Statistical Office of the Republic of Serbia on population trends of Serbia published in the Survey of the „Population Projection of the Republic of Serbia 2011–2041“, the number of people aged over 65 years will increase from 17.3% to 25.2%. Besides, the number of people aged over 80 years will increase from 3.5% to 7.8%, while the average age of the population will be 46.5 years (Statistical Office of the Republic of Serbia, Republic of Serbia, 2011).

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Aging is defined as a persistent decline in the age-specific fitness components of an organism due to internal physiological degeneration (Rose et al., 2012). The aging leads to an increase in the number of chronic diseases (heart disease, arthritis, diabetes, obesity, and stroke), the severity of the disability and limited functionality (Bjorn, 2016). Almost 80% of people over 65 have at least one chronic illness, while 50% suffer from two or more diseases (Centers for Disease Control and Prevention, United States and worldwide, 2003). Increasing risk factors in the elderly lead to an increased incidence of falls. The causes of the falls can be divided into internal and external factors (Lord et al., 2007).

The category of external risk factors for falls in the elderly includes physical environment (insufficient light in the room, slippery floor, uneven surface, irregular stairs, lack of handrails), inappropriate walking aids or assistive devices (cane, stroller, walker), inappropriate (large) footwear, slippery surfaces of the footwear insoles, high heels (Lord et al., 2007). Falls are the leading cause of fatal and non-fatal injuries in people over 65 years of age (Bergen et al., 2016). On the other hand, injuries caused by falls are the fifth leading cause of mortality (Kannus et al., 2005), which is the high position if other health conditions that often affect the elderly population are taken into account, such as heart disease, cancer, stroke, lung disease.

Available scientific studies indicate that older age and falls affect the ability to maintain balance. Difficulties in maintaining balance occur with age, and it has been found that “older” elderly are more prone to falls than “younger” elderly (Demura, Yamaji, & Kitabayashi, 2005; Steffen, Hacker, & Mollingesr, 2002) have examined age-related differences in dynamic balance in the elderly using four tests. A decreasing number of steps and the increasing average ground connecting time during stepping were noted in older subjects, in contrast to the younger ones. Another study found that the elderly had increased body sway. This study consisted of two stances (self-selected, narrow) and two visual conditions (eyes open, eyes closed). Based on the research results, age is a significant predictor of increased body sway velocity and that with age, body sway velocity increases (Riemann et al., 2018). Similar study results were reported by Butler et al., (2009). Using seven different tests, with balance as the main parameter, they found that older subjects had worse performance than younger ones (Butler et al., 2009).

Research aim is to examine the effect of falls and older age on balance performance among elderly population.

METHOD

The survey was conducted during July and August 2017 within the Home for Adult and Elderly Persons “Bežanijska kosa” (Belgrade), as well as within the day clubs for the elderly, sponsored by the Gerontology Center, Belgrade. Consent to conduct the research was approved by the Board of Directors and the Director of the Home for Adult and Elderly Persons “Bežanijska kosa”.

Procedure and data collection

Potential candidates, with the help of a social worker, were introduced with the research, the activities that are expected of them, the manner of realization of the activities, the exclusion criteria, and the research aim. Those candidates who met the criteria and who wanted to participate have confirmed their consent in writing. Data on the health status were obtained through an interview with the participants themselves, used solely for scientific research purposes. and could not be connected with the person's identity.

Criteria for exclusion from the study in both groups were less than 65 years of age, inability to stand and walk independently, use of mobility aids or devices, presence of ophthalmic (cataract, glaucoma) and neurological diseases (stroke, Parkinson's and Alzheimer's disease), illness and injuries of the musculoskeletal system (arthritis, lumbar syndrome, hip fracture in the last two years), surgical cardio-vascular interventions in the last year, and vestibulopathy.

A special two-part protocol was created for data collection. The first part of the protocol included demographic data such as gender, age, education level, marital status, as well as the History of Falls Questionnaire (Mayers, Young, & Langlois, 1996).

The second part of the protocol included basic anthropometric measures, such as body weight and height, based on which each subject's body mass index was calculated, as well as balance tests. Two tests were used to evaluate the static balance, One Leg Stance Test – Eyes Open (Springer et al., 2007), and a modified Romberg test (Agrawal et al., 2011; Briggs et al., 1989; Guralnik et al., 1995; Rossiter-Fornoff et al., 1995), which were performed on Wii Balance Board (Kyoto, Japan, 2007). The tests used to evaluate the dynamic balance were the following: Four Step Square Test (Dite & Temple, 2002), Time Up and Go Test – Motor/Cognitive Task (Shumway-Cook & Brauer, 2000), 360 Degree Turn Test (Gill et al., 1995), and Timed 10-Meter Walk Test (Bohannon, 1997). Before performing the tests, the examiner gave verbal instructions first, then visually demonstrated the position or action required of the subject to perform, and finally, the subject performed one trial. The break between each repetition lasted at least one minute, that is, two minutes between performing the tests themselves. During the break, the subject was allowed to sit if needed. The subjects repeated each test three times and the best result was scored. Subjects performed static balance assessment tests without shoes, while dynamic balance assessment tests were performed in footwear that they normally used. The testing process itself was carried out continuously throughout the day in a pre-arranged term and schedule.

Sample

The study included a total of 142 subjects, 75 (52.8%) male and 67 (47.2%) female. The age of the subjects ranged from 64 years and five months to 89 years and six months, mean age 73 years and 11 months (SD = 6 years and 2 months). The range of years of education of the subjects ranged from 8 to 19, M = 12.82 (SD = 2.25). There were 86 (60.6%) subjects living with their family and 56 (39.4%) subjects living alone in the household.

Instruments

History of Falls Questionnaire (Mayers, Young, & Langlois, 1996) was used to collect data form those subjects who had sustained a fall in the past 24 months. In this study, a fall is defined as a sudden and unintentional change that causes a person ”to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects” (WHO, Global Report on Falls Prevention in Older Age, 2007). This definition is supplemented by the definition of Kellogg (according to Zecevic, Salmoni, Speechley, & Vandervoort 2006), who points out that a fall as “unintentionally coming to the ground or some lower level and other than as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure”.

The Wii Balance Board (Kyoto, Japan, 2007) is a device (dimension: 45 x 26.5 x 3.5 cm; weight 3.5 kg), which has four sensory transducers installed below the standing surface, located at each corner of the board: top left, top right, bottom left and bottom right. These sensors, whose primary function is to convert one physical size to another, in the case of the Wii Balance Board, involve converting a vertical force into electrical signals that can measure its distribution in a horizontal plane. By measuring the electrical signals coming from all four sensors, especially when the person is standing on the platform, it is possible to accurately determine the pressure centre, i.e. the balance point as projected vertically below, on the surface. The centre of pressure of the body, i.e. its total movement, can be monitored and recorded in the anteroposterior and mediolateral direction of movement.

For proper functioning and measuring of the user’s centre of pressure of the body in relation to the surface using the Wii Balance Board, it is necessary to provide certain technical prerequisites. First, the data on the shifting of the user’s centre of pressure is transmitted wirelessly via Bluetooth to the laptop from the Wii Balance Board (in our study we used the Lenovo 110-15IBR and Windows 7). Second, to read the parameters, there is a need for specially designed software that graphically displays the imprint of the user’s centre of pressure on the laptop screen. For this purpose, we have used the “Posturo Balance” software (Sport Medical Solutions, version 1.3.0, Faculty of Sport and Physical Education, University of Belgrade).

We used various modifications of the Romberg test to assess static balance (Agrawal et al., 2011), some of which were combined with a cognitive task. The motor tasks themselves are designed to activate the vestibular, visual and somatosensory systems to a greater extent. The tests were performed according to their level of difficulty, i.e. from a position of greater stability to a less stable position. The test is considered unsuccessful if a person uses his or her hands to maintain balance, is unable to maintain the required position for a predicted time (time is recorded), opens his or her eyes early in some tasks, or makes more than five errors in a cognitive task. The modified Romberg test is a commonly used test to assess the balance and risk of falls in healthy individuals over the age of 65. If a person is unable to hold the required positions for a period longer than 10 seconds, then he or she is considered to be at increased risk of falling.

The first task requires the subject to stand on the Wii Balance Board with their feet at least 15 cm apart, arms relaxed next to their body and eyes open, head straight, and to maintain this position as steadily as possible for a period of 30 seconds. In the second part of this task, the examiner requires the subject to remain in the same position, except with eyes closed. The third test is combined with the cognitive task, and the subject has to count backwards for the same period, with his / her eyes open starting from 100 by subtracting seven. This task is given just before the start of the test (Pajala et al., 2008).

In the second task, the subject was asked to put the feet together so that heels and toes were touching, to position arms relaxed next to the body and open eyes, and to maintain the required position as steady as possible for 30 seconds. After performing this task, the test is repeated with closed eyes (Bohannon et al., 1984).

In the third task, the balance is evaluated on a narrow stance. Subjects are required to look straight ahead and position one foot to the other one by putting the thumb of one foot next to the inner side of the heel of the other foot. A subject should maintain this position for a period of 20 seconds (Pajala et al., 2008).

One Leg Stance Test – Eyes Open (Springer et al., 2007) requires the subject to stand on the dominant leg (without shoes) as steady as possible for 30 seconds. The subject should bend one leg at the knee, fold his arms across chest, look straight, while the examiner measures time with a stopwatch. The test is stopped and time recorded (in seconds) if the subject touches the floor with the bent leg, uses his or her hands to maintain balance, moves the standing leg to maintain equilibrium, stand longer than 45 seconds. If the subject is unable to perform the test for more than five seconds, then he or she is considered to be at increased risk of falling. The dominance of lower extremities was determined by using a battery of tests for dominant lateralization assessment within the framework of “General Defectological Diagnostics”, such as kicking the ball (the leg with which the person kicked the ball is the dominant one) (Ćordić & Bojanin, 2011).

The Four Step Square Test (Dite & Temple, 2002) is a clinical test that assesses the ability to change direction while stepping, and it includes a cognitive component. To perform the test, a stopwatch and four canes (90 cm long) are required. Four canes should be set-up like a cross on the floor. On the examiner’s sign “Step”, the subject should, while standing in the square no. 1, step into square no. 2 (located in front), then in the square no. 3 (located on the side) and then take a step back to square no. 4. When in square no. 4, the subject should return in the same direction to square no. 1 and then time stops. Subjects are required to complete the task as quickly as possible, but when stepping, they should make sure not to touch the canes, and that both feet should make contact in each square. If possible, the subject is asked to look straight while performing the task. The test is considered unsuccessful if the subject makes contact with the cane or loses balance. If the subject takes more than 15 seconds to perform the test, that subject is considered to be at increased risk of falling.

Performing the Time Up and Go Test – Motor/Cognitive Task (Shumway-Cook & Brauer, 2000) involves a motor task. Subjects are required to sit on a chair (45 cm high, without handles) and hold a glass filled with water in one hand of their choice. On the examiner’s sign “Go”, they should get out of the chair and walk three meters to the cone, then turn around and then return to the chair the same way. With a stopwatch, the examiner measures the time it takes the subject to perform this motor action. During the test, the cognitive task implies that the subject is counting backward by seven from 100 while walking. If the subject needs more than 15 seconds to complete these tasks, he or she is considered to be at risk of falling.

The 360 Degree Turn Test (Gill, Williams, & Tinetti, 1995) was used to evaluate the dynamic balance. The subjects were asked to stand on a line of adhesive tape previously glued to the floor, and to make the full circle in place on a verbal sign "Go", so that they would finally return to their starting position, shoulders facing forward to the examiner. The examiner uses a stopwatch to measure the time, as well as the number of steps it takes a subject to perform this motor action. Research shows that if it takes more than 3.8 seconds for an elderly person to turn around itself in a full circle, then increased risk of falling is indicated.

The Timed 10-Meter Walk Test (Bohannon, 1997) was used in clinical practice to assess functional mobility and gait in individuals. The test measures the gait speed (in seconds) in relation to distance (in meters). The test is very easy to perform, the examiner marks a distance of 10 meters on the floor with adhesive tape before testing, and then, within that distance, further marks the second meter and the eighth meter. Subjects are required to position themselves behind the first line and to start at normal speed to the last line at the tenth meter. The stopwatch measures the time from the moment when the subjects cross a line at the second meter and stops when the subjects cross a line at the eighth meter, so that gait speed is measured over a distance of six meters, while the first two meters and last two meters serve for speeding up or slowing down the speed of walking. A walking speed of less than 0.7 m/s is a predictor of fall.

Statistical data processing

Survey data were processed using descriptive and inference statistics methods. The processing was performed in the Statistical Package for Social Sciences (SPSS) computer program, version 20. We used the following descriptive statistics measures: arithmetic mean, standard deviation, percentage. In the inference statistics, we used multivariate analysis.

RESULTS

The two-way multivariate analysis of variance was used with the following factors: fall (has sustained a fall; no history of fall) and age category (categories: 65–75 years; 76–85 years). Indicators of static and dynamic balance were selected as dependent variables, in order to examine whether there were statistically significant main effects of factors of experienced fall and age category and a significant effect of the interaction of these factors on indicators of static and dynamic balance. Multivariate analysis of variance takes into account the interrelationships of the dependent variables, in this case, the correlations of indicators of static and dynamic balance. The results of the analysis are presented in Table 1.

Table 1. *Results of two-way multivariate analysis of variance, dependent variables – static and dynamic balance indicators; factors –fall and age category*

Balance Tests	Factor	F	df	*p*
Wide stance with eyes open (ml.)	Fall	0.34	11	0.563
	Age category	2.97	11	0.088
	Fall x Age category	6.28	11	**0.014**
Wide stance with eyes open (ap.)	Fall	2.57	11	0.112
	Age category	1.42	11	0.236
	Fall x Age category	1.59	11	0.211
Wide stance with eyes closed (ml.)	Fall	0.01	11	0.945
	Age category	0.34	11	0.582
	Fall x Age category	2.85	11	0.089
Wide stance with eyes closed (ap.)	Fall	0.02	11	0.882
	Age category	7.81	11	**0.006**
	Fall x Age category	11.22	11	**0.001**
Wide stance with a cognitive task (ml.)	Fall	1.41	11	0.239
	Age category	3.07	11	0.083
	Fall x Age category	0.32	11	0.562
Wide stance with a cognitive task (ap.)	Fall	2.84	11	0.095
	Age category	1.27	11	0.262
	Fall x Age category	0.34	11	0.562
Closed stance with eyes open (ml.)	Fall	2.13	11	0.147
	Age category	3.70	11	0.058
	Fall x Age category	1.08	11	0.302
Closed stance with eyes open (ap.)	Fall	0.97	11	0.328
	Age category	0.17	11	0.677
	Fall x Age category	0.95	11	0.332
Closed stance with eyes closed (ml.)	Fall	0.44	11	0.509
	Age category	2.57	11	0.112
	Fall x Age category	6.62	11	**0.012**
Closed stance with eyes closed (ap.)	Fall	0.307	11	0.581
	Age category	4.40	11	**0.039**
	Fall x Age category	11.58	11	**0.001**
Semi-tandem stance (ml.)	Fall	444.39	11	**0.000**
	Age category	129.97	11	**0.000**
	Fall x Age category	0.18	11	0.671

Balance Tests	Factor	F	df	*p*
Semi-tandem stance (ap.)	Fall	730.79	11	**0.000**
	Age category	103.64	11	**0.000**
	Fall x Age category	0.00	11	0.957
One Leg Stance (ml.)	Fall	77.67	11	**0.000**
	Age category	21.12	11	**0.000**
	Fall x Age category	1.30	11	0.257
One Leg Stance (ap.)	Fall	102.13	11	**0.000**
	Age category	25.65	11	**0.000**
	Fall x Age category	0.65	11	0.799
Four Square Step Test	Fall	0.50	11	0.481
	Age category	6.86	11	**0.010**
	Fall x Age category	0.92	11	0.339
Timed Up and Go (motor)	Fall	2.81	11	0.097
	Age category	4.40	11	**0.039**
	Fall x Age category	0.61	11	0.436
Timed Up and Go (cognitive)	Fall	3.13	11	0.080
	Age category	12.44	11	**0.001**
	Fall x Age category	2.11	11	0.150
10m Walk Test	Fall	1.29	11	0.259
	Age category	1.09	11	0.299
	Fall x Age category	0.30	11	0.587
360 Degree Turn Test – left (number of steps)	Fall	0.65	11	0.424
	Age category	1.72	11	0.193
	Fall x Age category	0.01	11	0.903
360 Degree Turn Test - left (time)	Fall	4.42	11	**0.038**
	Age category	1.18	11	0.280
	Fall x Age category	0.04	11	0.849
360 Degree Turn Test – right (number of steps)	Fall	0.83	11	0.363
	Age category	2.03	11	0.158
	Fall x Age category	0.05	11	0.821
360 Degree Turn Test - right (time)	Fall	4.18	11	**0.044**
	Age category	0.91	11	0.342
	Fall x Age category	0.03	11	0.871

Note: ml – mediolateral direction; ap – anteroposterior direction; F – Fisher statistics; df – degrees of freedom; *p* – probability.

Table 1 shows a statistically significant main effect of the variable related to fall on the following measures of balance: shifting of the user's centre of pressure in the mediolateral and anteroposterior direction on the task of standing with feet partly put together and on the test of standing on one leg ($p < 0.001$) and time recorded for the 360-degree turn on left and right ($p < 0.05$).

Our data show that there is a statistically significant main effect of age category on the following measures of balance: shifting of the user's centre of pressure in the anteroposterior direction on the task of standing with the feet together and eyes closed ($p < 0.05$), on the change of the centre of pressure in both the anteroposterior and mediolateral direction on the task of standing with feet partly put together and the One Leg Stance Test ($p < 0.001$), the Four Step Square Test and the Time Up and Go Test – Motor/Cognitive Task ($p < 0.05$).

A statistically significant effect of the interaction of the factor of fall and the category of age on the following indicators of balance was confirmed: shifting of the centre of pressure in the mediolateral direction when standing with the feet apart and eyes open ($p < 0.05$), shifting of the centre of pressure in the anteroposterior direction with the feet apart and eyes closed ($p < 0.05$), shifting in the centre of pressure in both directions with the feet together and eyes closed. All these effects of interaction were statistically significant at the 0.05 level ($p < 0.05$).

DISCUSSION

The results of our study show that elderly people with a positive history of falling manifest significantly poorer dynamic (longer test time) and static balance on some balance tests. More precisely, a greater shifting of the body's centre of pressure was found in the mediolateral and anteroposterior direction of movement during standing on the Wii Balance Board, compared to younger adults who did not experience a fall.

Available research suggests that aging also leads to difficulties in maintaining balance (Steffen, Hacker, & Mollingesr, 2002). Demura et al., (Demura, Yamaji, & Kitabayashi, 2005) examined gender and age-related differences in dynamic balance in the elderly based on four stepping tests. They used a device that measured different parameters during stepping, such as foot contact time, number of steps during a certain time period, etc. The results obtained by the authors indicated significant differences by age in all test situations. Older subjects, in contrast to younger ones, performed fewer steps over a given period, while having an increased average ground connecting time during stepping.

As confirmation of previous research that over the years the ability to maintain body balance becomes more unstable and the risk of experiencing falls higher, we can cite the results of a study that found that the elderly have increased sway velocity. The subjects stood on a force platform on a wide and narrow stance with two visual conditions (eyes opened, eyes closed). Based on the research results, it was found that the age of a significant predictor of body sways velocity and that with age, the body sway increases (Riemann et al., 2018).

Similar results were obtained by Butler et al., (Butler et al., 2009). They examined age-related differences in functional mobility in the elderly using seven different tests. The balance was the main parameter for the success of the activity. The sample was divided into younger and older groups. The results indicated that older participants performed significantly worse than the younger ones.

Furthermore, based on the previous scientific and empirical material, it was found that older participants who reported having fallen had a poorer balance than those who did not experience a fall (citation). Using a force platform, Melzer et al., (Melzer, Benjuya & Kaplanski, 2004) have examined postural balance as a risk factor in the elderly who reported having fallen and those who did not. The authors have found a statistically significant difference between the groups in balance tests performed on a narrow base stance. The elderly participants who experienced recurrent falls had a significantly increased overall displacement of the body's centre of pressure during standing on the force platform, increased sway of the centre of pressure, as well as increased mediolateral body sway on open-eyed tasks during narrow base stance compared with participants who did not experience the fall.

The results of a study by Lin et al., (Lin et al., 2004) indicate that the elderly who experienced a fall in the Standing and Walking Test, which measures the time it takes a person to get out of a chair, walk three meters, and return, have increased average task completion time (16.8 seconds) compared to participants who did not experience the fall (12.9 seconds). In the Grasping Test, in which participants were asked to stretch their arms as far forward as possible without stepping, distances achieved were significantly longer in participants who did not experience the fall (15.1 centimeters) compared to elderly participants who experienced a fall (11.5 centimeters).

Toulotte et al., (Toulotte et al., 2006) compared different gait parameters in healthy elderly fallers and non-fallers. The results indicate that the elderly persons who experienced the fall had different gait and balance control parameters compared with the healthy elderly who did not experience a fall. On the single-leg balance test, subjects who experienced a fall touched the floor three times more often than subjects who did not experience a fall under eyes open conditions, and twice as often with their eyes closed. Statistically significant differences were found between groups in the gait parameters (cadence, speed, stride and step time, single-support time), which were worse for the group of fallers.

CONCLUSION

The results of our study indicate that the elderly who experienced a fall had a significantly poorer dynamic and static balance compared to young adults who did not fall.

The falls experienced every year worldwide by an increasing number of the growing population of third-age persons are a very serious social and medical problem. The falls, directly or indirectly, can cause temporary or permanent physical, psychological, social and economic problems that significantly limit the independence and quality lifestyle. The consequences of the fall have a negative impact, both on the persons who had fallen, their families, and the health care system that deals with the treatment and rehabilitation of the injured.

We can conclude that falls in the elderly represent a global social phenomenon, which knows no boundaries. Raising awareness of this problem is not only health but also a general national task that needs to be further worked on.

More specifically, we tested the elderly only during one encounter, instead of being longitudinally monitored and examined on several occasions over a longer period, for example, one year. Recommendations for future research could be to examine the balance in, for example, the populations of elderly people in nursing homes. This population has also been recognized in the literature for its unstable balance and at high risk of experiencing falls. Moreover, the balance could also be examined in elderly patients on hospitalization or those who have some third-age specific chronic illnesses (arthritis, diabetes, neuropathies).

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