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THE EFFECTS OF EARLY REHABILITATION ON COGNITIVE STABILITY IN CHILDREN WITH SPASTIC CEREBRAL PALSY

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SUMMARY

Aim: To examine cognitive stability in children with spastic cerebral palsy.

Method: The study included 152 children with spastic cerebral palsy (CP), between ages of 6,0 and 14,6, who started habilitation treatment at the Special Hospital for Cerebral Palsy and Developmental Neurology in Belgrade before they turned one year of age. Children with epilepsy, quadriplegia and total FIQ<70, as well as with partial IQ (VIQ or PIQ) <80 were exempt from the study. Verbal IQ, performance IQ and full scale IQ were observed as target variable. The age included in WISC test, as a measure of the time elapsed from the occurrence of injury, functional status of fine and gross motor skills, the presence of visual impairment, retardation in early psychomotor development (PMD), residing at home or infirmary as an indicator of social environment were observed as potential independent variables.

Results: Most of these variables showed a certain degree of relation with the WISC basic measures, especially with the FIQ and PIQ, while VIQ demonstrated independence from these factors, except being in connection with early PMD. Visual impairment and early psychomotor development proved to be a more important determinant of later cognitive ability than motor disorders. Effects of age, expressed through higher scores of FIQ in younger children than in older, were significant when the age was analyzed in combination with the status of visual perception. Social environment did not appear significantly associated with any variable.

Conclusions: Considering the type of data that were available, these findings are rather seen as guidelines for future work than as unequivocal suggestion for making broader conclusions, but they certainly indicate the need for more systematic monitoring and stimulation of cognitive maturation of these children from the beginning, through the different stages of development, more specific early habilitation procedures, as well as for a greater degree of focus on the socio-psychological aspects of their maturation.

Key words: spastic cerebral palsy, general intellectual ability, time elapsed from the occurrence of injury, visual impairment, early psychomotor development

INTRODUCTION

Although cerebral palsy (CP) is a very broad and diffuse nosological qualifier which includes various forms of clinically manifested motor disorders of heterogeneous ethiopathogenesis (excellent review in Ashwal et al., 2004), it also designates proportionally particular situation of early static brain injury that is recognizable and often accompanied by cognitive limitations (Fennell & Dikel, 2001; Murphy, Yeargin-Allsopp, Decoufle & Drews, 1993; Nordmark, Hagglund & Lagergren, 2001), and literature offers precise information about their distinctive and disharmonious profile (Olsen, Pääkkö, Vainionpaa, Pyhtinen & Jarvelin, 1997; Pirillo et al., 2004, 2007). However, when cognitive development is viewed as a function of the time that elapsed from the occurrence of injuries (typically, in the period preceding the birth or around it), in other words, when the abilities of children with CP are observed from the perspective of child's overall experiential participation and learning while growing up, the findings are becoming less consistent: while some suggest that abilities of this population, general or in specific domains, decline over time (for example, Banich, Levine & Kim Huttenlocher, 1990; Daghlen Sandberg, 2006; Gonzales-Monge et al., 2009; Levine, Kraus, Alexander, Suriyakham & Huttenlocher, 2005), others assume their relative stability (Muter, Taylor & Vargha-Khadem, 1997; White & Christ, 2005). In the context of observation of lesions and their consequences as essential factors for further cerebral maturation and development of future interaction in general, one can assume a number of factors that could potentially influence the findings, including, as a minimum, the type, extent and localization of the lesion itself (Ashwal et al., 2004; Krageloh-Mann, 2007), 'initial' quality of interaction with the environment (Biagioni, Bartalena, Boldrini, Pieri & Cioni, 2000; Chilosi, Cipriani, Bertuccelli, Pfanner & Cioni, 2001; Goodman & Yude, 1996) but also, more specifically, the presence of motor and sensory limitations, starting from the first days of the child's life (Guzzi et al., 2001; Jakobson, Ek, Fernell, Flodmark & Broberger, 1996).

There is a growing recognition of the role of social participation as part of an integrated and stimulating cognitive development and vice versa, as well as progress in understanding how its deficiency can slow the development of cognitive functions and abilities (Aylward, 2002 Liptak & Accardo, 2004; Morris, Kurinczuk, Fitzpatrick & Rosenbaum, 2006). In order to get a better understanding of cognitive impairment in children with spastic CP, it is necessary to determine how limited participation in social activities influences their cognitive development (Ladd, 1990). Speech and language disorders affect the level of participation in various activities at school, during classes and breaks (Schenker, Coster & Parush, 2005a, 2005b). General cognitive functioning (expressed through IQ) may indicate the gravity of neurological problems (Goodman & Graham, 1996), i.e. it may indicate the slow maturation or lesion of the neural system which can cause problems in social adjustment and building positive social relationships (Nadeau & Tessier, 2006; Yude, Goodman & McConachie, 1998). This also applies to the executive functions that are most responsible for processing information relevant to social skills, as well as for visual perceptiual damage (Schenk-Rootlieb, Van Nieuwenhuizen, Schiemanck, Van der Graaf & Willemse, 1993). Developmental psychology has a long tradition of studying the impact of children's social participation and interaction in cognitive development and acquisition of knowledge and skills (Piaget & Inhelder, 1998; Rogoff, 2003). The basic condition for building an image of the world is the child's active participation in the social context in which he or she adopts various mental skills necessary for understanding scientific concepts and performing mathematical operations, which in turn enables a child to participate in new ways in new, different situations thus encouraging his or her cognitive and social development. Neuroconstuctivist dynamic interactive model (Botcher, 2010; Gottlieb, 2007) takes into account the lesions of the brain and particular neuropsychological impairments, their impact on cognitive functions, which have implications for social participation, which affects the development of cognitive functions and their impact on the reorganization of the brain regions.

It is essential to find out more about the interaction between biological maturation and cognitive development and learning through participation in social situations, so that we can explain the possible development trajectories in children with spastic CP.

In this paper, we were interested in late cognitive abilities of children with CP and whether some of the potentially important factors can be singled out as particularly influential. Our analysis included the functional motor status (fine praxis skills and gross motor skills, and control posture), visual status, the impact of early psychomotor development and the impact of socio-psychological factors depending on whether the child develops within the family environment or reside in the Hospital's infirmary.

METHOD

Subjects

This retrospective study included 152 children with spastic cerebral palsy who underwent the habilitation treatment before they turned one year at the Special Hospital for Cerebral Palsy and Developmental Neurology in Belgrade, excluding children with epilepsy (in order to satisfy the prerequisite of static early injure), of ages between 6,0 and 14,6 at the time of cognitive testing (done in the period from 1994 to 2014). In addition to restrictions on spastic CP, the sample included only children with approved prenatal or perinatal etiology of disease and with normal to near-normal intellectual abilities (IQ with a total score of 70 or higher, or partial (PIQ, VIQ) coefficient of 80 or more). The reason for the introduction of partial IQ quotients as an additional criterion in the formation of the group is often emphasized VIQ-PIQ discrepancy in this population, which may lower the overall IQ score by more than two standard deviations below the expected value for the age. The study included only children with hemiplegia or diplegia, since application of performance tasks in composite intelligence test is not possible in children with quadriplegia. All children had early ophthalmologic and audiometric reports, but only 76 children had a certificate of early psychomotor development testing (Munich Functional Development Diagnostics or Brunet-Lezine scale), so, this reduced sample was used in the analysis that concerned early psychomotor status. Since only a negligible proportion of children in the sample had CT/MR report, 'risk-factors', such as gestational age, weight and Apgar score, were controlled and monitored, but since none of these, especially the maturity of the fetus at birth as a potential, indirect marker for lesion ethiopathogenesis (Ashwal et al., 2004; Okumura, Hayakawa, Kato, Kuno & Watanabe, 1997), showed no significant correlation with achievement on tests of cognitive ability, they were not mentioned in further elaboration.

Procedure

General intellectual abilities of these children were assessed with WISC. The study covered only those test protocols which were given and evaluated in accordance with modern requirements of psychological assessments of the persons with physical and/or sensory impairments (Briggs, Dial, Morere & Joyce, 2007). However, even after the necessary modifications some problems of administration, evaluation and interpretation of the results in this population remain, primarily due to motor limitations (for example, in controlling the fine motor skills or due to forcibly altered lateralization of the dominant hand). Thus, here, in a case of time-limited subtests, none of the subjects, regardless of the presence, type and degree of impairment, did not receive extra points as a bonus for solving speed. Because for various reasons a number of subjects was not given a complete performance scale, the total number of subjects, whose PIQ was analyzed, was reduced to 119. In addition to this, due to incomplete medical history, not all subjects were analyzed using all the variables.

Fine motor skills were assessed using the Manual Ability Classification System (MACS), a method that allows a systematic functional classification of manual skills in children with CP when using objects in everyday activities (Bappsc, 2007; Eliasson et al., 2006). The scale assesses achievement in five ordinal categories. As all the children included in this study were assessed in the context of some of the first ('easier') three categories of the scale and because the number of subjects assessed in the third category was small (total of five), two evaluation were obtained: absent/discrete limitation of fine motor skills (MACS category 1) and mild limitation (MACS categories 2 and 3).

In assessing the gross motor skills, a similarly designed five-level scale, Gross Motor Functional Classification System (GMFCS) was used, based on the assessment of spontaneous movement with special emphasis on the control of the body and walking, with the primary criteria that functional differences between the level/category must be clinically significant (Morris & Bartlett, 2004). Estimated with this scale, gross motor skills of children in our sample varied between the first and fourth level, but these assessments were re-categorized in the dichotomous variable, where one group consisted of children with minimal/mild limitation of body control and independent movement (GMFCS 1 and 2) while other one consisted of children who must rely on apparatus (GMFCS 3 and 4).

As already mentioned, all children undrwent clinical ophthalmological and audiological examination. Data for sole subject with hearing impairments were excluded from further evaluation, while the vision test findings were divided into two categories – children who have no visual impairment or have only mild limitation of visual acuity corrected with glasses, and those who have other forms of visual-perceptual restriction, except previously singled out (typically, strabismus and amblyopia).

Since the findings of the applied the Munich and Brunet-Lézine scales were sometimes recorded only descriptively, only two-thirds of the children having them, the results were divided into the group with a normal or near-normal early psychomotor development and the group that corresponded to "borderline delay" or 'mildly slow' PMD.

Home/infirmary variable refers to the social environment in which children live most of the year. One group consists of subjects who live at home with their parents or guardians, while the second group consists of subjects who stay at the Hospital's stationary department during the school year where they reside, have their therapies and attend classes. From time to time, mostly during long holidays and school holidays, they go home.

Standard statistical methods for quantitative analysis compatible with the implementation of categorical independent variables were used in analysis of the results.

RESULTS

Descriptive data for all three IQ scores offered by WISC are presented in Table 1. The total IQ is displaced in relation to the expected mean by almost one SD downwards with positively skewed distribution of results: most scores are concentrated on the left side of the curve (Figure 1), which is partly the result of the criteria set for the selection of the sample. The difference between the means of VIQ and PIQ in favor of verbal ability is evident and not accidental (ANOVA for repeated measurements gives $F=54.382$, $p<0.001$, partial $eta^2=0.315$). As it was expected for this population, we noticed a high frequency of extreme discrepancy between achievements in the subscales: the number of children with a difference VIQ-PIQ being more than 20 points exceeds one-third of the total sample, while the largest recorded difference was as high as 52 IQ points.

Table 1 *WISC results*

	N	Min	Max	M	SD
FIQ	152	54	124	85.48	15.33
VIQ	152	61	135	90.73	15.70
PIQ	119	43	115	78.39	16.30

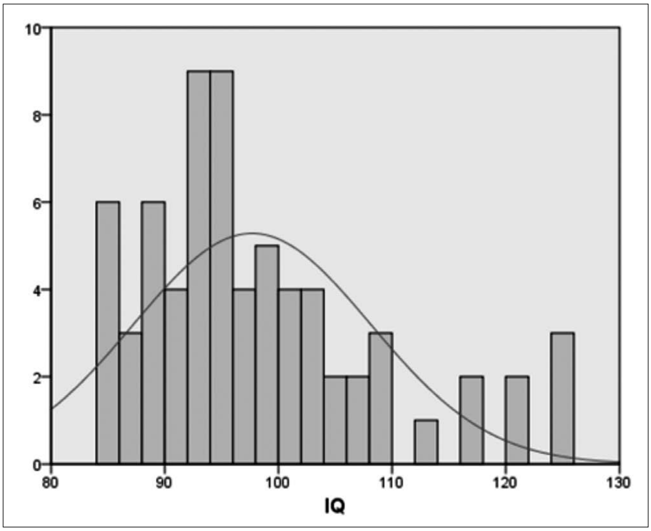

Figure 1 Distribution of IQ scores within the sample

Integrity of the motor skills, presence of the sensory (visuospatial) deficit and early psychomotor status of the organization show, individually, a distinctive influence on the obtained values of IQ scores, while social environment has no significant effect (Table 2).

Table 2 *Mean values of performance on WISC for examined predictors*

		MACS			GMFCS			vizPerc			rPMR			home/infirmary		
		M	SD	N**	M	SD	N**	M	SD	N**	M	SD	N**	M	SD	N**
FIQ	1.0*	87.55	14.98	47	86.24	14.80	70	86.25	13.93	71	89.00	15.58	45	84.30	14.20	88
	2.0	80.86	13.25	72	79.95	12.65	49	78.74	13.24	47	78.84	10.87	31	81.26	14.49	31
	Total	83.50	14.28	119	83.50	14.28	119	83.26	14.09	118	84.86	14.66	76	82.78	14.35	119
PIQ	1.0*	84.40	15.92	47	82.76	15.91	70	82.42	15.58	71	83.13	15.94	45	80.43	16.31	88
	2.0	74.46	15.41	72	72.14	14.88	49	71.70	14.98	47	75.06	16.92	31	82.58	16.02	31
	Total	78.39	16.30	119	78.39	16.30	119	78.15	16.16	118	79.84	16.72	76	81.51	16.16	119
VIQ	1.0*	92.00	16.84	47	91.24	16.36	70	91.44	16.04	71	96.02	16.10	45	90.25	15.67	88
	2.0	89.18	13.97	72	88.94	13.30	49	88.02	13.27	47	85.55	9.28	31	91.52	15.81	31
	Total	90.29	15.16	119	90.29	15.16	119	90.08	15.04	118	91.75	14.61	76	90.88	15.74	119

*for the independent tested variables, 1.0 denotes subgroup with a better status (preserved motor skills – MACS and GMFCS, visual percepcion – vizPerc, early psychomotor development – rPMR), while 2.0 denotes subgroup with poor status, except for the home/infirmary variable where 1.0 denotes home, and 2.0 infirmary.

**due to incomplete medical histories, some cases were not included in the analisis

Groups separated according to MACS and GMFCS differ significantly in value of FIQ and PIQ (respectively, $F_{2'150}$=16.966, p<0,001, eta^2=0,184 and $F_{2'150}$= 16.794, p<0.001, eta^2=0,183 for FIQ; $F_{1,117}$=11.540, p<0.001, eta^2=0,090 and $F_{1,117}$=13.528, p<0,001, eta^2=0.104 for PIQ), but not for VIQ; since the effects are small, two-way between groups ANOVA (MACS*GMFCS) produce results that fall just below the acceptable significance (respectively, p<0,189 and p<0,056 for FIQ, p<0.064 and p<0.077 for PIQ), although AS values decrease progressively for subgroups of children who have higher, i.e. both types of motor limitations. Similar effects are recorded when visual impairment is viewed as an independent variable (differences between groups for FIQ and PIQ are significant, respectively p<0,001, partial eta^2=0,192 and p<0,001, partial eta^2= 0,106, while not significant for VIQ: p<0,236, partial eta^2=0,009), with a slightly modified 'form' of the results when it comes to the findings of the early psychomotor development testing (for the dependent variable FIQ, a difference of 11,29 points is significant for p<0.001, partial eta^2= 0,141, and for PIQ it is slightly lower, AS(M1-M2)=8,07, p<0,038, partial eta^2=0,057), but contrary to the previous, the means of VIQ (average difference between AS=9,63) differ significantlyt (p<0,010, partial eta^2=0.097). By testing the interaction of the effects of the perception deficit, early PMD and MACS (which was selected last due to proportionally greater effect on FIQ and PIQ in relation to GMFCS) one gets a model (Figure 2) where the largest, although small, individual contribution to the subsequent FIQ is obtained through ePMD (p<0,004, partial eta^2=0,087) and then through visual limitation (p<0,047, partial eta^2=0,043), while the effect of MACF loses statistical significance (p<0,387, partial eta^2= 0,008). For PIQ, as the only important factor, with a slightly larger effect, presence of the visual perceptual damage stands out (p<0,004, partial eta^2=0,116), while for IQV early status of the psychomotor organization is the only important factor (p<0,003, partial eta^2=0,085). Although proportionally higher percentage of children with proper ePMD had no visual impairment (75:25%), it should be noted that Pearson Hi^2 for all three independent variables showed no statistically significant association (Hi^2=2,668, df=1, p<0,078).

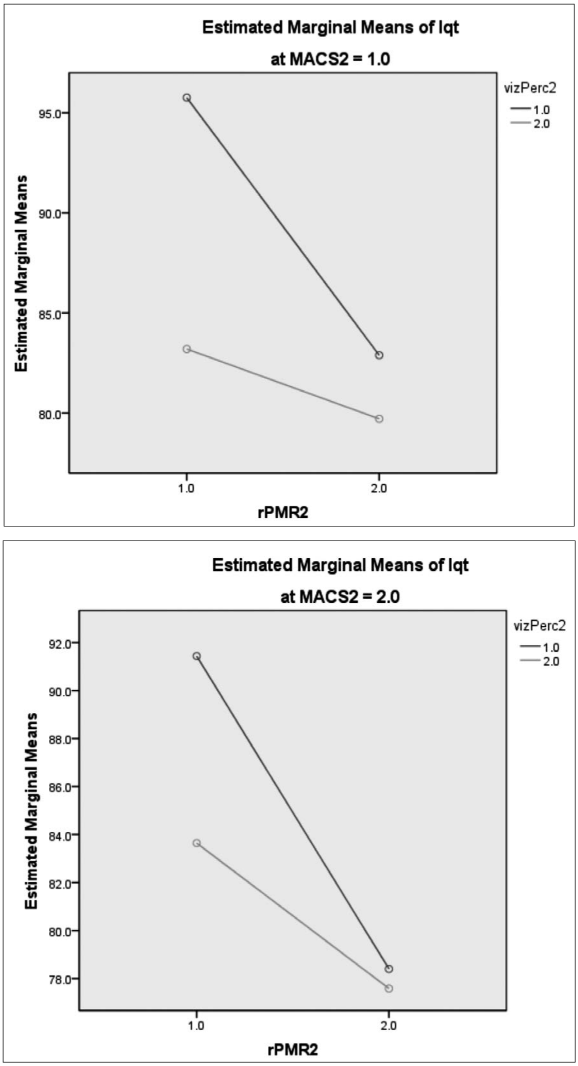

Figure 2 Mutual interactions of early psychomotor development (rPMR2), sensory deficit (vizPerc2) and fine motor skills deficiences (MACS) as dichotomous independent variables for the dependent FIQ (Iqt)

Age at testing of intellectual abilities with WISC, expressed in months, here observed as an indicator of the time elapsed from the occurrence of injury, manifested in the preliminary check its poor, but significantly negative connection with the obtained values of IQ (rho=-0,21, p<0,01; Figure 3). Although linear regression indicates that age contribution to the changes of FIQ is barely noticeable (part.R^2=0,03), Beta value of 0,189 possess statistical significance (p<0,02). Therefore we this transferred this variable into dichotomous one and tried to compare its impact with the previously isolated 'predictors' of the proportionally utmost importance for IQ among subjects, primarily, with the effects of visual and early PMD impairments. The established division border for groups of 8 years of age (96 months) is somewhat arbitrary and intuitively established, but beside the fact that the sample is evenly split (Nyounger:Nolder=75:76) this division roughly corresponds to the traditional assumption of Piaget on the period of transition to a higher operational intellectual level, but also to the neuropsychological record that suggests a qualitative change in the conceptual organization around this age (for example, Banich et al., 1990). Not quite beyond expectation, one-way ANOVA showed that the average difference between FIQ in younger and older children (87,31:82,83) is just below the level of significance ($F_{1,150}$=5404,069, p<0,055). However, when the effects of age at testing were checked along with the status of visual perception (presence or absence of visual impairment), its proportionate share in collecting variance increases to the level of significance (F= 5,495, p<0,02). However, visual perceptual status (F=13,196, p<0,001, partial eta^2=0,082) still affects significantly the differences between thus intersected groups, which are recorded in the range from AS=90,58 in younger children with better preserved visual perception to AS=76,85 in older children with greater vision impairment (AS residual values are 82,40 and 85,36). Similar effect of age is neither recorded in comparison with the findings of the early organization of psychomotor skills (ePMD remains the only significant factor in the model), nor when the other independent variable is preservation of fine motor skills (MACS maintains significance). Due to the low overall size of the obtained effects, such contrasts for PIQ were not checked since this sample was downsized by almost one fifth.

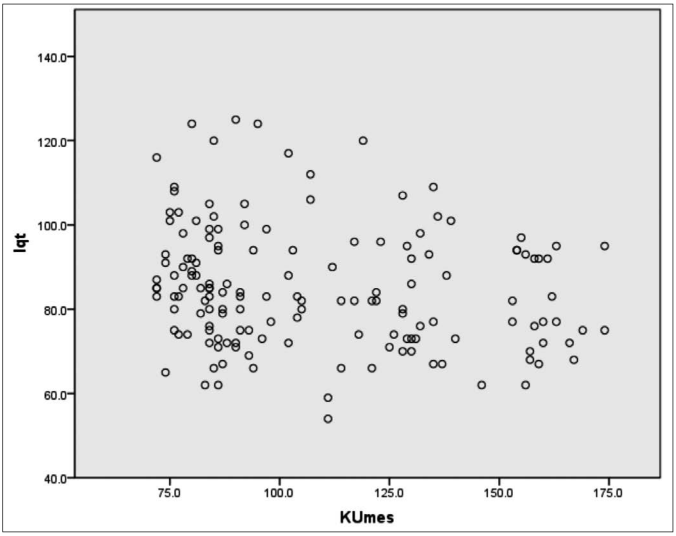

Figure 3 Individual achievement in FIQ (Iqt) depending on the age at testing with WISC (X axis – chronological age expressed in months – KUmes)

DISCUSSION

When we look at the cognitive development as a resultant of continuous dynamic interaction of biologically determined path of cerebral maturation and child's active selection and processing of environmental information that will modulate the growth (Quartz & Sejnowski, 1997; Thomas & Karmiloff-Smith, 2002), the presence of early brain injury can be seen as additional, important factor that interfere with these processes. Expression of disturbances that we may face in the child's everyday life is achieved through years of practicing a particular way of data processing and through fixation of neural representations of that processing (Karmiloff-Smith, 2009; Sirois et al., 2008). Plasticity of the immature brain, i.e. its increased predisposition to alter under various influences (Stiles, 2000), can lead to very different outcomes of an early structural damage, ranging from extremely favorable to those who have much worse consequences than comparable lesions of the mature brain (Forssberg, 2008; Karmiloff-Smith, 2002; Stiles, Reilly, Paul & Moses, 2005; Thomas, 2003). Since the understanding of the factors that cause one or the other outcome is a matter of vital importance, the research of the late consequences of the early cerebral lesions stands out as one of the indispensable approaches in an attempt to comprehend them better.

From this perspective, if the support we provide to these children is appropriate, then, at least in this group, for which we can assume that from the beginning had a slightly better development potential, we can expect proportionately better capabilities later. Research by Aram and Eisele (1994) points out possibility of stabilization of cognitive development over time through compensatory mechanisms and plasticity of the preserved brain structures. The authors studied children with unilateral spastic CP and found a normal or near-normal level of intellectual achievement in both groups (left-sided and right-sided damage). If the abilities of children with CP are 'stable' and do not change significantly to the level of mature cognitive organization, then one can expect that there is no significant connection between age and performance on the cognitive tests, i.e. average performance of younger and older children will not differ significantly.

The findings of the simple processing of basic measuring indicators in the test (FIQ, VIQ, PIQ) reflect the cognitive profile characterized by spastic CP where, in contrast to almost normal verbal disturbances, disturbances in visual perceptual organization appear as dominant (Ito, Araki, Tanaka, Tasaki & Cho, 1997; Pirillo et al., 2004), here represented by the extremely reduced scores on the 'manipulation' subscale. The age shows mild although consistent link with FIQ at the expense of older children. This connection is to some extent facilitated through the presence of early perceptual deficit. Other examined factors, although they make differences in one IQ level or another, did not show significant connection with this, and the only psycho-social variable, home/infirmary, did not prove to be a significant factor.

Among many factors that are recognized as possible sources of atypical or altered cerebral, and thus cognitive maturation, we chose here (or we could choose) disturbances of sensory (more precisely, visual) organization, integrity of the motor skills, and (non)deviation of early psychomotor development, with the assumption that each of them represents a developmental factor that acts from the very beginning of the child's interaction with the environment. Additionally, visual-perceptual organization is a typical *locus minoris* in children with spastic CP (Barca, Cappelli, DiGiulio, Staccioli & Castelli, 2010; Scheiman, 1984; Stiers, Vanneste, Coene & Vandenbuscche, 2002), motor deficit is the essence of the diagnosis itself (for example, Bax, Goldstein, Rosenbaum, Paneth & Leviton, 2005), and delay in early psychomotor development is a relatively general indicator of the quality of early interactions with the environment, no matter how unreliable it may be considered (Chilosi et al, 2001; Romeo et al., 2016; Wood et al., 2005). Our results, in general, showed significant effects of each factor. However, the home/infirmary variable had no significant effects. We can assume several reasons. One of them is that children in the infirmary actually get a better stimulation than at home, i.e. if home conditions are of poor socio-cultural level, or if the parents are not ready (willing), or are not able to engage sufficiently in meeting their children's social, psychological and cultural needs. Further, similar to the previous, children with disabilities are still not fully accepted in their wider social environment, in contrast to the infirmary where they have a maximum commitment of the staff, as well as the social environment of peers with similar disabilities. The latter, the infirmary environment, may be an advantage but also a disadvantage. On the other hand, children who live at home may not meet their need for social contacts to the appropriate extent. In one word, home/infirmary variable proved insufficiently discriminative, but we think that this aspect should be given more attention in a future study, and the variable itself should be precisely defined and divided in a number of components.

A number of studies actually suggest that overall capacity in children with CP could decline over time, as observed for some other clinical groups, for example, in children with (specific) disturbances in cognitive maturation. So, for example, Levin and associates, in the paper focused on the children with congenital hemiplegia, tested with WISC in different intervals (1.5-15 years), before and after seven years of age, found that their IQ score decreased with time (Levine et al., 2005), while Gonzales-Monge and associates found for the same form of CP decline in PIQ only (Gonzales-Monge, 2009). Other authors record similar findings for particular cognitive abilities, as well (for example, Dahlgren Sandberg, 2006, for reading and working memory). In addition to generalized assumptions about the potential influence of early injuries to the development of interactions and the possibility of their gradual complication (eg, Stiles et al., 2005), one of the possible explanations for these findings is that the cerebral white matter lesions, the most common cause of spastic CP, may compromise the quality of transmission of information or interactions between different areas of the brain, and early impairments 'on the periphery' of cognitive processing may endanger the later maturing of higher cognitive functions (Anderson, 2007).

The importance of an early intervention aimed at changing this relation lies in the ability to incite stimulating reciprocal interaction between neurobiological constraints caused by early brain injury and neuropsychological potentials in the context of adequate social and psychological environment (Bottcher, 2010).

Reliance on standard clinical information, recorded in the medical and psychological documentation during treatment and health monitoring of children with spastic cerebral palsy, determined to a large extent the selection of variables, methods of processing, but also the overall design of the study. Therefore, our findings suggest that existing information can be useful when we talk about some current issues of cognitive abilities in this population. The cognitive profile of children with spastic cerebral palsy who have normal or mildly reduced general abilities is, as a whole, decidely atypical than suggested by the amount of total IQ score. The presence of sensory or motor limitations and retardation of early psychomotor development are seen as relevant factors for the future effectiveness of cognitive organization. There was also a negative correlation between age and overall intelligence quotient. Although the relative influence of each of these factors is proportionately low, they point to potentially significant issues in supporting these children. At an early stage the attention is mostly paid to stimulation of motor skills (through kinesy therapy), control and possible correction of vision and hearing are left to parents, while the development of visual perceptual skills and visual motor skills is not sufficiently monitored; early psychomotor development is not monitored systematically, and the importance of social participation is not emphasized and is not encouraged enough. Systematic monitoring of cognitive maturation through different stages of development, the introduction of neuropsychological assessment in the proceedings and focusing on the socio-psychological aspects of the child's development could significantly contribute to the quality of involvement of psychologists in this population. It is necessary to emphasize that the monitoring of cognitive development should begin in a timely manner (as soon as possible) and be continuous, and stimulation of cognition, particularly visuospatial organization in connection with early vision correction should begin as soon as possible. Social integration should be monitored by psychologists and special education teachers continuously from the beginning.

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