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Neuromotor Status and Behavior Problems in School Children

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ABSTRACT

Background/Purpose: *Prevalence of behavior problems in school children ranging from 8% to 35%. The causes of behavioral problems are often attributed to socio-cultural factors and interpersonal relationships and not to biological factors like neuromotor condition. Neuromotor condition often stay undetected in population of Serbian school children, also relationship between neuromotor condition and behavior problems are not studied. The aim of the research is to verify whether atypical neuromotor condition is important for occurrence of behavior problems. Participants included 256 elementary students from second-, third-, and fourth-grade classrooms.* ***Method:*** *Using the Developmental Screening Test (DST), the children's neuromotor condition was assessed. Behavioral problems were detected using the Strengths and Difficulties Questionnaire (SDQ) for teachers.* ***Results:*** *Statistical analysis has shown that behavior problems were more common in participants from the group of atypical neuromotor condition (12 participants or 28.57%) in contrast to the group of those with typical neuromotor condition (24 participants or 11.22%). The degree of behavior problems was higher in those children whose degree of neuromotor problems was higher. There was a statistically significant difference at the $p<0.05$ degree in SDQ scores for the groups: $F(2.253) = 8.414$, $p=0.001$.* ***Conclusion:*** *We can conclude that atypical neuromotor condition is important for occurrence and grade of behavior problems in children.*

Keywords: Motor development, Neuromotor maturity, Behavior problems, School children, Primary school

INTRODUCTION

Research has shown that in a population of school children behavior problems occur. Prevalence rates of reported behavioral problems vary from country to country. In seven European countries on a sample of 7682 children aged 6 to 11 years old prevalence [1] of 12.8% was reported. The highest was in Lithuania (15.5%), and lowest in Italy (7.8%). In Saudi Arabia, the prevalence of behavior problems on a sample of 924 school children was significantly higher, at 36.3% [2]. From these data, it is clear that the behavior problems are present in school children in a significant percentage in different parts of the world.

In order to prevent the emergence of negative behavior, it is important to research the reasons and causes for such behavior. Causes of behavior problems in children of school age, are not well understood because of its complexity. This is well explained with the biopsychosocial model of occurrence of negative behaviors in school children which was developed by Dodge and Pettit [3]. The model is built on the basis of accumulated knowledge of many researchers in the field [4-8]. It shows the interactions and predictors of behavior problems. Authors [3] compared the study of behavioral problems with the study of heart disease. One factor is never the only cause, but development of behavior problems depends on many. They define several groups of factors, which, as demonstrated by numerous researches, may influence behavior: biological predisposition [9-13], socio-cultural context, parenting, relationships with peers and teachers [14-19]. Children can have such initial neurological, endocrine, psychophysiological disposition, in certain socio-cultural contexts, which could place them on the path to possible behavioral problems later in life.

The child is born with a certain neurological status that can influence the later emergence of behavioral problems. Neurological problems such as disease or structural damage (e.g. cerebral palsy) may be responsible for the occurrence

of atypical behaviors. Some diagnosed conditions leading to atypical neuromotor status, which basically have no clear etiology (disease, impairment), can also lead to behavior problems. Atypical neuromotor status is often present in premature infants, most likely as a result of lack of adequate neurological and structural maturing. However, atypical neurological status may occur at a later age in a term born children and children with regular Apgar scores and neurological status after birth. In children may be present minor neurological dysfunction (MND) as a result of a prenatal problems or may occur in children who are not recorded with any neurological problems at birth. For all children, the prevalence of MND presence grows until puberty, when sharply declining. It is believed that the number of children with MND increases as the nervous system matures (e.g. myelination individual nerve structures can last after thirty years) and some of its parts start to be actively used at a later life [20]. Studies of minor neurological dysfunction suggest that in children with hypotonia, mild pathological reflex activity, problems of coordination and fine manipulative skills, these problems contribute to the occurrence of behavior problems such as antisocial and impulsive, as well as withdrawn and fearful behavior in relationships with teachers and parents [21]. Depending on the type of minor neurological dysfunction association with the emergence of unwanted forms of behavior is stronger or weaker [20-22]. Children with neurological soft signs have a higher probability for the presence of behaviors with anxiety and withdrawal symptoms, and also emergence of psychiatric disorders, with domination of these behaviors, in later life [23]. Also, in children with soft neurologic signs was found a positive correlation between the presence of these signs and impulsiveness. Reasons for the existence of this relationship are sought in neurological dysfunction or immaturity [24]. In children with neurologic soft signs, soft signs were associated with excess internalizing problems [25].

When children have developmental coordination disorder (DCD), they have greater behavior problems compared to the typical population of school children [26]. Comparing a group of children with DCD, suspected DCD in relation to the group of children of a typical population, according to the scores on the Child Behavior Checklist (CBCL) [27], it was found that children with DCD and suspected DCD are more withdrawn, expressing more somatic complaints have a higher degree anxious/depressed behavior compared to children without DCD. About externalizing behaviors, children with DCD and suspected DCD expressed a higher level of delinquent and aggressive behaviors, social problems, thought problems, and sex Problems [26]. In relationships with teachers, externalizing problems such as hyperactivity, aggression and conduct problems are dominant. In relationships with parents, externalizing problems and adaptive behavior problems of adaptability, social skills, leadership functional communications are significantly greater [28].

The child at birth was first confronted with the unknown external environment which is full of unknown stimuli, which needs to be organized in a comprehensible system in order to survive in the new world. The stimuli are coming to all the senses and the infant must be able to respond to them. Response to these stimuli represents the first forms of child behavior, and therein lies a possible explanation for the link of neuromotor status and behavior [29].

The response to external stimuli is possible because the child is born equipped with a system that is able to produce spontaneous motor activity (SMA). The first SMA that occurs even during intrauterine development represents the beginning of the road towards the adoption of the first rudimentary behavioral forms. According to the modern developmental model that was developed by Marques, Bharadwaj and Iida [30], SMA allows the child to meet its own skeletal-muscular system and the environment, allowing it to have the first sensory experiences.

These sensory stimuli further trigger reflex circuitry, whose reaction is in the form of a motor response can be further modulated by the higher centers. The child is equipped with a set of primitive reflexes that exist for the sake of survival, especially in the first weeks of life [31]. They emerge and last for a specific period, and then disappear or become inhibited through modulation. Often replace each other. Most of them are eventually inhibited, and instead of SMA and poorly modulated reflex responses, begins domination by the voluntary motor patterns under the control of cortical structures. Cortical structures do not assume their intended roles immediately after birth, because they are not matured morphologically and physiologically. There is a hierarchy in which neural structures mature and take over the functions of control of motor activity by modulating reflex activity toward domination of voluntary motor action. Spontaneous motor activity and reflex modulation, have an important role in practicing the child to perceive and correctly integrate sensory stimuli from the vestibular, proprioceptive, tactile, auditory, and visual-perceptual senses [32]. Children with atypical neuromotor condition have problems in these areas. In the early work of Ayres, she

argued that children with motor coordination problems had difficulty integrating visual, vestibular, proprioceptive, and tactile information. Wilson and McKenzie [33] in their meta-analysis suggest that children with DCD, between the ages of 5 and 16 years, have the associated problems of the visual spatial processing, kinesthetic perception compared to children of typical population.

Neuromotor status of the child should not be seen solely through the motor and neurological signs as is usually done in studies the presence of soft neurological signs, MND and DCD, but also through its ability to perceive and integrate sensory information, because they are just as important not only for the modulation of a ratio of spontaneous and reflex motor activity [30] on the way to voluntary motor skills, but also to understand the world that surrounds us and responding to stimuli from it in the form of behavior. Therefore, neuromotor status can be seen through the persistence i.e., inadequate modulation of primitive reflexes, features od motor coordination, balance, oculomotor function, visual perception, visuomotor integration and sound recognition [30,32,34]. All these aspects are essential features of neuromotor status. From neuromotor status of the child depends on the further development, i.e., how the child will understand the world. It is possible that atypical neuromotor status of the child in any of these aspects can lead to atypical further development, which could lead to inadequate perception of the world and the interactions that govern it, which could be contribute to the formation of what society defines as behavior problems.

Neuromotor status defined in this way according to Goddard [34] illustrates the overall neuromotor characteristics of the child in a onetime point during the development, in which, according to the above-mentioned characteristics can be compared to peers. For us, this is important because in Serbia, after the birth of child, primary health care system have role only in detecting serious neurological conditions and neurological diseases, as well as the serious sensory conditions and diseases. Subtle neurological, motor, and sensory signs remain undetected. The prevalence of children with the diagnosis of DCD is unknown in Serbia. Based on the practice can be assumed that it is far below the prevalence of which are mentioned in the literature, which indicates the possible failures in detection of DCD cases [35]. Detection of these problems is not present even in the context of educational institutions during the preschool, as well as during the primary education of the child. The most frequent associates in Serbian schools are psychologists and the general educators, whose tasks are not directed at detecting these problems. Young inclusive practice is currently using all its resources to provide support to children diagnosed with developmental disabilities, while children of typical population remain beyond the scope of special educators and rehabilitators who are present only and strictly when needed in educational institutions.

On the other hand, behavior problems are very present in the school environment. In this regard, psychological and pedagogical support is available, but mostly deal with interpersonal relationships (parent, teacher, student) and the influence of the environment and the economic status of the child's behavior [36]. Possible impact of neurodevelopmental status of the child to the occurrence of negative behavior remains completely ignored. This research will be the first to provide insight into the current situation.

During research on the relationship neuromotor status of the child's behavior we should take into account some of the factors that may affect the child's behavior, and which has been identified and included in Dodge and Pettit [3] model.

We should not ignore the child's environment and interpersonal relations of teachers and students in that environment. In the period from the first to the fourth grade, students are spending most of the time in thair classroom with one teacher who is lecturing most of the subjects to them. Therefore, we are of the view that the relationship neuromotor status of children and behavior should be explored in the context of different grades, not the context of entire sample. Also, children of the same grades, in the same way passed through the state system of health and social care in terms of diagnostics in the compulsory medical examinations. They have also gone through the same psychological and educational assessment within the school system. We believe that through the analysis of neuromotor status and behavior relationship in the context of grade we would simultaneously consider: age, educational expectations, expectations regarding behavior. The validity of the results would be significantly higher due to the appreciation of the context in which the child is.

Therefore, the aim of this study was to investigate whether in our sample are present children with atypical neuromotor condition compared to their peers from the same grade. It is also intended to establish to what extent the neuromotor status of children is essential to the presence of behavior problems, as well as whether there is a relationship between the grade of atypical neuromotor condition and degree of the behavior problems that occur in younger school children.

We expect to find the existence of a connection between neuromotor status and behavior, and that we will be able to detect the relationship of an atypical neuromotor condition with different types of negative behaviors discussed in the literature, no matter what we observe this relationship from the context of the students' grade. Confirming these results would further highlight the importance of neuromotor status of children in developing positive behavioral patterns.

METHODS

Information on demographic characteristics of students were obtained from school records. Then neuromotor condition of children was assessed by using DST. Assessment was done by two special educators-rehabilitators, individually with each child. Special educator rehabilitators were specially trained to use DST through online training on website of The Institute for Neuro Physiological Psychology, Chester, UK. Teachers, class supervisors, were asked to fill out SDQ questionnaires about children's behavior for children from class they were supervising. Special educator rehabilitators were blinded to the SDQ scores during DST time of assessment. Also, teachers, class supervisors, was blinded to purpose of the study and didn't have any knowledge about DST and DST results.

From the obtained DST and SDQ scores for each student, we calculated mean scores for every grade from our sample. Based on mean score of grades, z-scores for each student was calculated.

If the calculated z score on DST was less than or equal to 1 we assumed that the student belongs to a group of students who have a typical neuromotor condition (TNMC) compared to other students from same grade. If the score is greater than 1 and less than or equal to 2, we will assume that the student belongs to the group of those who have mild atypical neuromotor condition (MANMC). If the score is greater than 2 we will assume that the student has severe atypical neuromotor condition (SANMC). We will consider that student belongs to atypical neuromotor condition group (ANMC) when the z score is greater than 1. In the same manner the z-scores were calculated from the final scores on SDQ, as well as the scores on SDQ subscales.

According to SDQ z-scores, participants were also divided into groups. The first group consisted of those participants whose z-scores were less than or equal to 1. This is a group which we called the group with the absence of behavioral problems (ABP). The second group consisted of those participants whose z-scores were greater than 1. This is a group with the persistent behavior problems (PBP). Groups were formed in the same way according to the z-scores for all subscales of SDQ: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, prosocial behavior problems.

We then compared TNMC and ANMC according to prevalence of those students who belonged to PBP group. Also, we compered TNMC, MANMC, SANMC groups according to SDQ z scores.

Participants

In the first phase, the research project has received the approval of the Faculty of Special education and rehabilitation, University of Belgrade, Serbia to conduct, with confirmation of the scientific and ethical correctness in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). We have obtained the approval of schools, parents, and teachers to conduct research. In accordance with the inclusion and exclusion criteria participants were selected (Figure 1).

The sample consisted of students of three elementary schools: Primary school "Zivko Tomic" (Topola municipality), Primary school "Dušan Radonjić" (Aranđelovac municipality) and Primary School "Ilija Garašanin" (Aranđelovac municipality) in Serbia. The sample consisted of approximately the same number of second, third and fourth grade students.

We also defined exclusion criteria for participation. First graders haven't been included in the sample due to the fact that teachers were not sufficiently informed about them yet to be able to give expert opinions about their school life. The sample did not include students who were classified as children with disabilities, students with the diagnosis of diseases of the nervous and muscular system, as well as students who had been diagnosed with psychiatric illness, students with intellectual disabilities, autism spectrum disorders.

Preliminary sample consisted of 327 students of the second, third and fourth grades. Of that number, for 21 students has not been possible to obtain the necessary parental consent. Criteria for inclusion in the sample were not met by 18 students. The final sample consisted of 288 students. At the time of testing 29 students were absent from school. For 3 students, teachers haven't provided a completed SDQ. Overall tested sample consisted of 256 students. The second grade was attended by 85 students (33.20% of all students), the third 82 (32.02% of all students) and the fourth 89 (34.77% of all students). Of the total sample, 131 or 51.20% of students were male. The average age of students was 9.73 years (SD=0.88). The youngest participant was 7.75 years, and the oldest was 11.42. There was no statistically significant difference in the number of students by gender and by age, and we can say that the sample was balanced according to these two criteria (Figure 1).

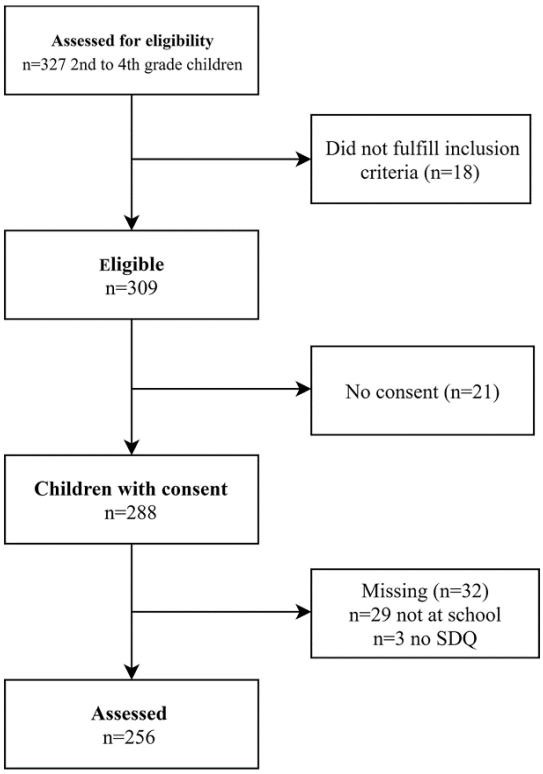

Figure 1 Flow diagram of participants

Measures

Neuromotor Condition

Developmental Screening Tests for Use with Children from 7 Years of Age (DST) aims to provide an overall picture of the degree of neuromotor maturity of the child [37-40]. It contains the following sets of tests: Tests for Gross Muscle Coordination and Balance, Tests for Aberrant Primitive Reflexes, Tests for Oculomotor Functioning, Tests for Visual-Speech Recognition, Tests for Visual Perception and Visual-Motor Integration [40-44]. In each of these sets of tests there are individual tests. Achievement in each of the tests is estimated at five-point scale from 0-4. When a child has no difficulty, score is 0. When 100% of dysfunction is present score is 4. Groups of tests have scores, which represent the sum of individual scores on tests of particular group in relation to the maximum possible score. The final score on all tests represents percentage of success. It is calculated as the sum of all the individual scores on tests which is then divided by the maximum possible score and multiplied by 100. Each of the tests involved in this screening test has excellent metric characteristics [40].

Behavior Problems

The presence of behavioral problems in children was evaluated using The Strengths and Difficulties Questionnaire

(SDQ). We used a version of the questionnaire, which is intended for teachers to assess the behavior of children aged 4 to 17 years [45]. The questionnaire consists of 25 items which are distributed into subscales: emotional symptoms (5 items), conduct problems (5 items), hyperactivity/inattention (5 items), peer relationship problems (5 items), prosocial behavior (5 items). The sum of the scores of the first four subscales of the SDQ gives a total difficulties score. Each of the 25 items of the questionnaire is a statement for which teachers are required to determine the extent of its truthfulness, marking one of the boxes: "not true", "somewhat true", "certainly true." Answers are scored as 0, 1 and 2 depending on whether the statement reflected a form of positive or negative behavior. Total difficulties score may range from 0 to 40, and scores for each of the individual subscales may range from 0 to 10. Psychometric properties of this instrument are good. Reliability was generally satisfactory, whether judged by internal consistency (mean Cronbach's $\alpha = 0.73$), cross-informant correlation (mean: 0.34), or retest stability after 4 to 6 months (mean: 0.62) [46].

Statistical Analysis

Data analysis and data processing is carried out through the use of Microsoft Excel and IBM SPSS Statistics 22 software packages. Of statistical techniques we have used descriptive (frequency, central tendency) and the discriminative (Chi-square test of independence, ANOVA of different groups). Flow diagram is drawn using the online package Flowchart maker & online diagram software.

RESULTS

The Frequency of Atypical Neuromotor Condition and Behavioral Problems

According to the instructions for scoring the instruments that was used, we calculated the scores on both instruments for 256 students. Table 1 shows the mean scores of students on DST [40] and SDQ [45] for the entire sample and by grades.

Table 1 Mean scores on DST and SDQ

Variables	All participants		Second grade		Third grade		Fourth grade	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
DST	17.91	9.5	19.89	9.25	18.81	9.61	15.19	9.1
SDQ	7.97	6.98	7.75	5.58	8.46	7.03	7.73	8.11
DST: Developmental Screening Tests; SDQ: Strengths and Difficulties Questionnaire; SD: Standard Deviation								

According to these data, the total number of participants with typical neuromotor condition is 214 or 83.59%, while the atypical neuromotor condition was present in 42 or 16.41% ($z>1$). Behavior problems haven't been recorded in 220 or 85.94% of participants, while the problems were present in 36 or 6.14% of participants (Table 2).

Table 2 Distribution of participants based on DST and SQD z-scores

Variables	TNMC		MANMC		SANMC	
	n	%	n	%	n	%
DST	214	83.59	31	12.11	11	4.3
SDQ	220	85.94	22	8.59	14	5.47
Emotional symptoms	218	85.16	27	10.55	11	4.3
Conduct problems	217	84.77	25	9.77	14	5.47
Hyperactivity/inattention	217	84.77	28	10.94	11	4.3
Peer relationship problems	206	80.47	39	15.23	11	4.3
Prosocial behavior problems	218	85.16	25	9.77	13	5.08
DST: Developmental Screening Tests; SDQ: Strengths and Difficulties Questionnaire; TNMC ($z \leq 1$); MANMC ($1 < z \leq 2$); SANMC ($z > 2$)						

The Difference in the Prevalence of Behavior Problems in Participants with Typical and Atypical Neuromotor Condition

A Chi-square test of independence showed the relation between prevalence of neuromotor condition and behavior

problems (Table 3). Students with atypical neuromotor condition (ANMC) are more likely to have present behavioral problems (PBP), compared to students with typical neuromotor condition (TNMC). They are more likely to have present hyperactivity, problems in relationships with peers, pro-social behavior problems (Table 4). A Chi-square test did not show a relation between neuromotor condition and presence of emotional symptoms, as well as a relation between neuromotor condition and presence conduct problems (Table 3 and Table 4).

Table 3 A Chi-square test of independence values for the relation between prevalence of behavior problems in typical and atypical neuromotor condition groups

Variable	Chi-square	df*	φ	p
Presence of behavioral problems	8.752	1	0.18	< 0.05
Emotional symptoms	3.195	1	-	0.07
Conduct problems	1.493	1	-	0.22
Hyperactivity/inattention	6.921	1	0.16	< 0.05
Peer relationship problems	6.09	1	0.15	< 0.05
Prosocial behavior problems	7.49	1	-0.17	< 0.05
*df = Degree of freedom; For the analysis of differences in the frequencies, the expected frequency in all cells was greater than 5				

Table 4 Frequency of present behavior problems, in typical and atypical neuromotor condition groups

Variables	PBP*		PES		PCP		PHI*		PPRP*		PPBP*	
	n	%	n	%	n	%	n	%	n	%	n	%
TNMC[a]	24	11.22	28	13.08	30	14.02	27	12.62	36	16.82	26	12.15
ANMC[b]	12	28.57	10	23.81	9	21.43	12	28.57	14	33.33	12	28.57
TNMC: Typical neuromotor condition; ANMC: Atypical neuromotor condition; PBP: Present behavior problems; PES: Present emotional symptoms; PCP: Present conduct problems; PHI: Present hyperactivity/inattention; PPRP: Present peer relationship problems; PPBP: Present prosocial behavior problems; [a]n=214; [b]n= 42; *p<0.05												

Group Comparison of Typical Neuromotor Condition, Mild and Severe Atypical Neuromotor Condition of Participants in Relation to the Degree of Behavior Problems

A one-way between subjects' ANOVA was conducted to compare the effect of atypical neuromotor condition on the degree of behavior problems measured by SDQ. Participants were divided according to the severity of neuromotor condition into three groups: TNMC. MANMC, SANMC. The degree of negative behaviors increased, (Figure 2) starting with a TNMC group (N=214, M=-0.10, SD=0.95) followed by a MANMC group (N=31, M=0.35, SD=0.92) followed by a SANMC group (N=11, M=0.95, SD=1.38). To assess the assumption of the homogeneity of variance, we have used Levene's test of equality of variance. The assumption of homogeneity of variances has not been violated. There was a statistically significant difference at the $p<0.05$ degree in SDQ scores for the three groups: $F(2.253) = 8.414$, $p=0.001$. There was an increase in SDQ scores of group of participants with MANMC compared to the mean score of a TNMC group. The mean increase in score of .45, 95% CI (-0.89, -0.01), was statistically significant, $p=0.043$. Also, there was an increase in SDQ scores of group of participants with SANMC compared to the mean score of a TNMC group. The mean increase in score of 1.05, 95% CI (-1.75, -0.34), was statistically significant, $p=0.002$. There has been no statistically significant difference between SDQ scores of MANMC group compared to the SANMC group. The mean increase in score of .60, 95% CI (-1.40, 0.20), was not statistically significant, $p=0.19$. The effect size, calculated using eta squared, was medium, $\eta 2=0.056$. Specifically, the more atypical neuromotor condition of participants is, present behavior problems are more severe (Figure 2). Groups were based on severity of neuromotor condition were: TNMC ($z \leq 1$), MANMC ($1 < z \leq 2$), SANMC ($z>2$); Error bars represent standard deviations.

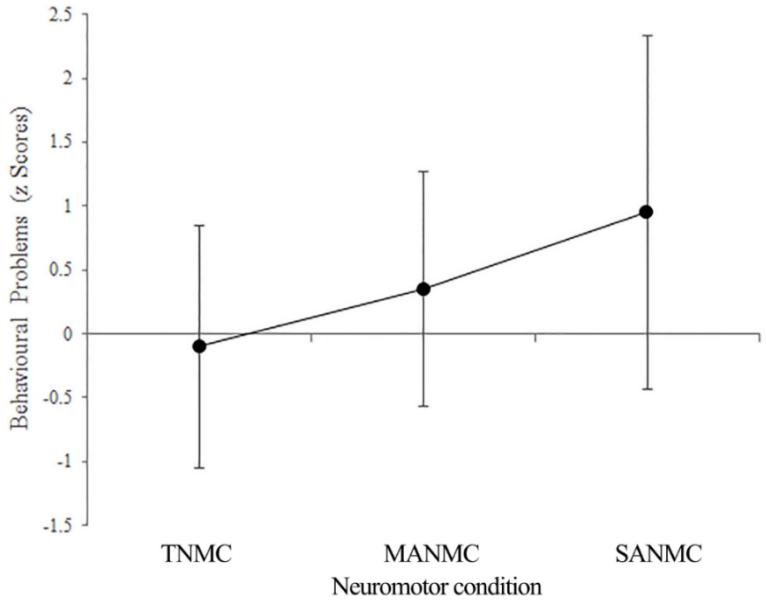

Figure 2 Mean differences in z-scores on SDQ for three different groups

DISCUSSION

We wanted to determine whether the severity of neuromotor condition in children, as one of the main biological characteristics, can, to some extent, be responsible for the formation of some behavioral patterns, i.e., whether the children with atypical neuromotor condition tend to, more often, develop different forms of behavior problems at school age. We also wanted to determine whether these behavioral problems are more severe in those participants whose severity of neuromotor condition was higher. To reach certain conclusions, we compared groups of students with typical and atypical neuromotor condition by frequency of present behavioral difficulties. Of the total number of participants atypical neuromotor condition have been present in 42 or 16.41%, and behavioral problems in 36 or 14.6%. We have found a statistically significantly higher prevalence of students with behavioral difficulties in the group of students with atypical neuromotor condition. Since the behavior of children is very broad term, we analyzed the frequency of occurrence of different types of behavior problems, using data obtained from the scores on the SDQ subscales. According to the obtained results, in population of younger school children who had atypical neuromotor condition, more common behavior problems were: hyperactivity and irritation, problems in relationships with peers and problems in the domain of prosocial behavior. Although obtained prevalence support the fact that the emotional problems and problems of conduct are also more common in children with atypical neuromotor condition, this tendency we could not verify using a Chi-square test.

In addition to estimating frequency of the overall presence of behavioral problems, and behavioral problems by type, we wanted to verify our assumption by comparing the overall grade of behavioral problems according to severity of neuromotor condition (typical condition, mildly atypical condition, severe condition). We demonstrated that the behavior problems tend to be stronger among the participants who belonged to a group with mildly and severely atypical neuromotor condition compared to those who belonged to group with typical neuromotor condition.

We found that in children with atypical neuromotor condition is more likely to be present hyperactivity and innate. Similar tendency is found by Kadesjo and Gillberg [47], i.e., that the presence DCD is strongly associated with symptoms of hyperactivity. There are several possible explanations. Atypical neuromotor condition and hyperactivity can both be due to non-optimal condition of the child's brain and nerve structures. Impulsivity and/or hyperactivity could be produced by impairments or immaturity of brain regions that have roles in inhibiting undesired or inappropriate motor behaviors [48,49]. Also, impulsivity and/or hyperactivity could adversely affect the results of neurological tests, which we consider to be a limitation of our research methodology.

Relationships with peers and prosocial behavior, unlike hyperactivity cannot be directly explained by the neuromotor status, because these behaviors are too complex and are subject to complex developmental processes. The result that

children with atypical neuromotor status are more likely to have problems in relationships with peers and problems in prosocial behavior can be explained in an indirect way, with atypical development of the child until the moment of testing. This atypical development may be due to non-optimal condition of the child's brain that is expressed through the neuromotor status of a child in the way we define it. Previous studies also support our results. In children with DCD compared to the typical population problems such as depression and withdrawn behavior are more difficult [26]. Children with DCD usually have present emotional problems, depression, problems of social communication, aggressive behavior, and poor self-esteem [50,51]. There is a connection between the symptoms of DCD and the listed behavior problems. It is also considered that even DCD has no clearly defined etiology, it is considered that it is the result of neuromotor immaturity [52]. In one research our results were supported from different perspective. Authors measured motor, speech-language, emotional and behavioral characteristics, in order to determine which difficulties can predict the motor skills in children of typical population [53] and found that hyperactivity and level of prosocial behavior predicts fine motor skills of preschoolers.

As we mentioned, in children with atypical neuromotor condition, it is the greater chance that emotional problems and conduct problems will occur, but for this claim we did not get a confirmation in the form of statistically significant results. Studies of DCD also support this relationship. In children with DCD are more common emotional problems [50,54,55] and conduct problems [22].

There are also studies that neuromotor status of the child treated as a weakness to establish good relationships with their peers and are in this respect the limit for expressing pro-social behavior. Boivin [56] believes that deviant physical attributes, such as speech problems, physical clumsiness, or disability, may lead to peer relation difficulties. When it comes to visible and detected impairments in children, peers may exclude them from their group, but still there is great chance that they understand their problems. In the case of presence of soft neurological signs, it is great chance that child with this atypical neuromotor condition and also his peers are unaware of his difficulties. Where there is no adequate detection of atypical neuromotor condition within the primary health care system or education system, as is the case in Serbia, teachers, associates in schools and parents are also unaware of the existence of atypical neuromotor condition of the child. Thus, these children remain not covered by the system, and their behavioral problems are being treated only partially.

In societies that have recognized the importance of neuromotor status of the child for behavior, are working on development of new types of interventions for behavior problems. Physical activity in healthy children can have a positive impact in terms of stimulating neurodevelopmental maturation [57]. In children (especially girls) who had increased physical activity incorporated into curriculum, there were fewer behavioral problems and fewer symptoms of hyperactivity compared to children which were experiencing standard level of physical activity [57]. Also, it is possible to develop other types of interventions that will further educate children to be tolerant towards diversity of children with atypical neuromotor condition.

Regardless of the precise causes of the relationship of atypical neuromotor condition and child behavior problems, such as non-optimal condition of the child's brain (immaturity, damage, atypical physiology, etc.) or atypical development as a result of such state of the brain, or socio-cultural connotations, children of younger school age with atypical neuromotor condition have higher risk for the presence of behavioral problems.

Neuromotor condition of students, could be an important determinant for the acquiring of positive behavior patterns, especially if we know that whatever the degree of atypical neuromotor condition is greater, the behavior problems are more severe. Our results are significant because they suggest that we should understand the importance of neuromotor condition of the children during their schooling. Socio-cultural factors and interpersonal relationships at school and at home are not the only important factors that may affect the formation of the behavior patterns of the child. Biological predispositions and, especially, neuromotor condition of the child should be equally in focus, when it comes to the study of etiology of behavior problems in children. We hope that the results we presented will be able to direct the attention of the future studies on this subject, with the aim of finding new ways of prevention of behavioral problems.

CONCLUSION

To summarize, children of younger school age with atypical neuromotor condition have higher risk for the presence of behavioral problems. This is especially true for problems of hyperactivity, relationships with peers and prosocial

behavior. There was a difference in the degree of behavior problems in relation to the severity of atypical neuromotor condition in children. The degree of behavior problems was higher in those children whose severity of atypical neuromotor condition was higher. The results we obtained are in agreement with the results of other research in the field.

DECLARATIONS

Conflict of Interest

The authors and planners have disclosed no potential conflicts of interest, financial or otherwise.

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