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CORRELATION BETWEEN STEREOTYPICAL MOTOR MOVEMENTS AND MOTOR DEVELOPMENT IN CHILDREN WITH AUTISM

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Abstract

Although the autism spectrum disorder (ASD) is a frequent topic of research, there are still many uncertainties and things that need to be discovered, in order to properly plan and implement treatment and enable maximum functional independence.

Considering that most studies refer to the assessment of the behaviour, social interaction, etiology of the autistic spectrum disorder, the main goal of our research was to determine the existence of a correlation between motor development and the degree of stereotypic motor movements in children with ASD. A sample consisting of 31 children with ASD aged 5 to 8 years was included in the research, and a gross motor assessment scale, a fine motor assessment scale and a repetitive behaviour assessment scale was used to obtain the necessary information.

According to the obtained results, we can conclude that there are large deviations in the motor development of children with ASD, both in gross and fine motor skills. The more pronounced the stereotypic movements, the greater deviations there are in motor development, and conversely, children who have a better coefficient of motor development have less pronounced stereotypic activities.

Early motor impairments are evident in children with ASD, especially in those later diagnosed with ASD. More research is needed to ascertain the clinical utility of motor impairment detection as an early trans diagnostic marker of NDD risk. Our view is that early stimulation and treatment of motor disorders will lead to a reduced frequency of stereotyped movements and better functionality.

Key words: *autistic spectrum disorder, stereotype movements, motor development*

Introduction

Developmentally, motor skills play a key role in shaping children's interactions with other people and their environments from infancy, and are thus intrinsically linked to social, communication, adaptive and cognitive skill development. The first communication skills to emerge — facial expressions, joint attention and proto imperative pointing — are all motor behaviours. Early

differences in motor behaviour could therefore have cascading developmental effects across domains. Motor skills may be the domain in which developmental divergence appears first (De Marchena & Zampella, 2022; Bauman, 1992).

The development of motor skills depends on the formation of complex connections between different parts of the brain that link sensory information from the body with information from the environment, plus our innate motivation to plan and execute motor movements. A number of theories about the origin of these motor difficulties that are so widespread in the neuro divergent population are encountered in the literature, but no theory is sufficiently developed and conclusive (Laurie, 2022; Wilson, Enticott, Reinhart, 2018):

- Differences in brain wiring - this may affect ideas and intentions, sensory integration, motor.
- Learning, prediction, body awareness, coordination and praxis.
- Joint hypermobility/low muscle tone - this affects core stability, postural stability, muscle strength and overall stamina.
- Anxiety - this can affect willingness to participate in challenging and novel tasks. It can lead to avoidance of activities and therefore a reduction in the development of motor skills.

Despite not being listed as a core trait of autism in the diagnostic criteria, differences in motor skill development are often the first traits seen in autistic children (Leiviska, 2023). In addition to the multitude of symptoms that pose a challenge for diagnosing ASD, there are also the manifestations of different types and degrees of motor disorders. Some of the most relevant signs of motor development delays in children with ASD described in the literature during the past few years: delayed motor development; persistent asymmetry when lying on the stomach at 4 months of age; righting from the supine to the prone position moving all the body end bloc not in a corkscrew fashion; abnormal patterns of crawling; walking asymmetry; sequencing instead of superimposition of one movement on the other for example during gait; unusual positions of arms; poor coordination; muscle tone and reflex abnormalities; choreiform movement of extremities; impaired finger-thumb opposition; stereotyped movements of the body, limbs, and fingers, including hand flapping; unusual gait patterns, including walking on tiptoes; poor motor imitation; impairment of postural control (Posar & Visconti, 2022).

In the development of the child, in the first months of life, we can notice a range of stereotypes, that is, repetitive movements, but later with the maturation of the nervous system and brain structures, they are lost. That is, as the child grows, his motor abilities also increase, gross and fine motor skills develop, as well as Oro-facial motor skills. In children with an autistic spectrum disorder, stereotyped movements persist, which significantly conditions the development of motor skills and less developed motor skills are often recorded (Kovachevska, 2022). Stereotypic behaviours (SB), also known as repetitive and restrictive behaviours, are one of the iconic symptoms in children with autism spectrum

disorder. An analysis of the literature shows that stereotypies often refer not only to movements, but also to other behaviours (e.g., posture, speaking, sniffing) that are classified as repetitive, while motor stereotypies are repetitive, rhythmic, often bilateral movements with a fixed pattern (e.g., hand flapping, waving or rotating) and regular frequency that can usually be stopped by distraction (e.g. calling one's name) (Péter, Oliphant, Fernandez, 2017).

Stereotypes can be classified as primary, meaning they appear to be purely physiological, or secondary, which exist in association with other psychiatric or neurological disorders (Muthugovindan and Singer, 2009; Péter, Oliphant, Fernandez, 2017). On the other hand, primary stereotypes can be classified into two groups, common (e.g., pencil tapping, hair curling, nail biting) and complex (e.g., hand waving, waving, finger wiggling, etc.) (Singer, 2009). About 20% of children exhibit common types of primary motor stereotypies, while primary complex motor stereotypies are estimated to affect 3-4% of children in the United States (Singer, 2009).

Methodology

Although deviations and delays in motor development are perhaps the first predictors of the autistic spectrum disorder, that is, they are the first noticeable manifestations, the number of researches covering this problem is still small. In that direction, the main goal of the research was to determine the existence of a correlation between motor development in children with an autistic spectrum disorder and the frequency of stereotypical motor movements. The methods of analysis, generalization and casualness were used for data collection, and documentation analysis and scaling were used as techniques. Instruments that were applied are the Scale for the assessment of gross and fine motor skills (Kid Sense Child Development, 2013) and the Scale for the assessment of stereotyped behaviour, in which the behaviour is rated according to a five-point Likert scale (RBS-EC / University of Minnesota, 2000).

The sample was consisted of 31 examinees, children with confirmed autism spectrum disorder, students in primary schools with resource centres "Idnina" and "D-r Zlatan Sremac" from Skopje (Fig. 1).

Figure 1. Age and gender distribution of the examinees

The main limitation of the study is the small number of respondents, which limits the possibility of generalization of the obtained results, although they are in line with the results of relevant research.

Results

According to the obtained results, we can conclude that we have large deviations in the motor development of children with ASD in both areas, that is, in gross and fine motor skills. In addition to having activities that the respondents can perform, the percentage representation of those activities that the respondents with ASD cannot perform is higher.

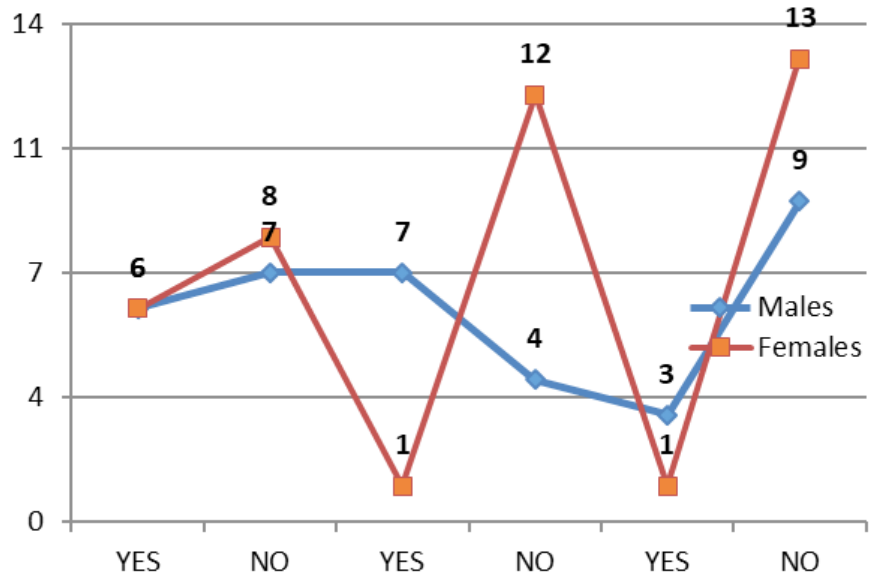

Figure 2. Gross motor development

Assessments of gross and fine motor skills were performed according to expectations for a given age. For the 5–6-year-old group, gross motor skills were assessed through 14 items such as standing on one leg for 10 seconds, throwing a ball, stepping backwards, etc. At the age of 7, the assessment took place through 15 items, and at the age of eight, 14 items. From figure 2, it can be seen that negative answers prevail among the majority of respondents, which indicates the impossibility of realizing given activities, with the fact that among boys aged 7 years in 5 categories there is an equal distribution of positive and negative answers and they are not included in the graph, the group of 8 years old in two categories has equal distribution. While for girls only at the age of 7 there is an equal distribution of positive and negative answers in 4 categories. The comparison by gender does not show a statistically significant difference,

but it can be noted that at 7 and 8 years of age girls have much more negative answers. At the age of 7, positive responses to assessments prevail among boys, unlike girls, where we have only one activity with dominant positive response and four activities with equal distribution of positive and negative responses.

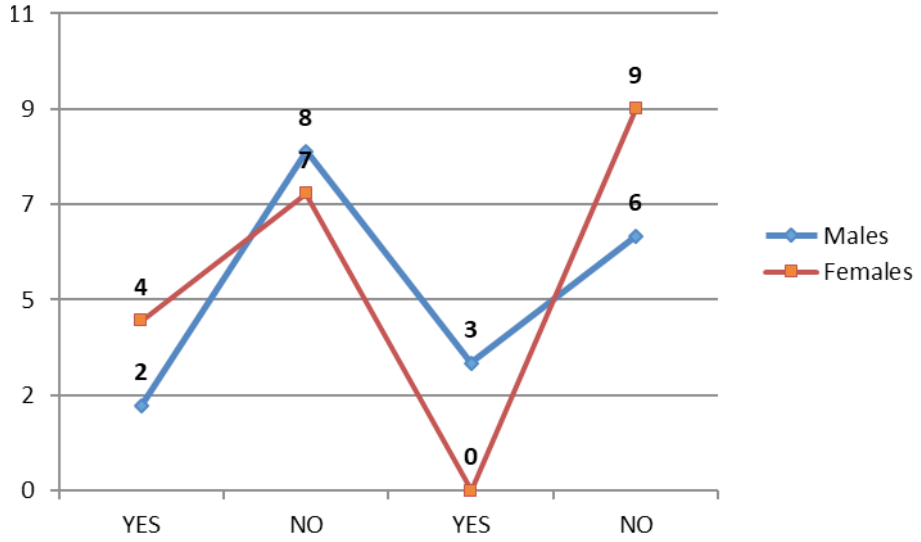

Figure 3. Fine motor development

The situation is similar in terms of fine motor skills (Figure 3), in both groups' unsuccessful attempts in the realization of activities given according to age dominate. At the age of 7 and 8, girls do not have any activity with a predominance of positive responses, while only in one category is an equal distribution of positive and negative responses observed. Assessments are made through activities such as correct formation of letters and numbers, unbuttoning and buttoning, cutting with scissors, modelling, etc.

The repetitive movements that are assessed, i.e., behaviours, are heterogeneous ranging from simple motor movements to complex patterns of routines and interests. The questions in this scale are divided into 4 groups: a) repetitive motor movements, b) rituals and routines, c) limited interests and behaviours and e) self-injurious behaviour. Each of the above-mentioned groups consists of several questions, and therefore in the analysis of the answers, larger values are noted, which means that more categories are assessed for each respondent. The behaviours were assessed on a five-point scale, 0 meaning it does not occur, 1 meaning it occurs once a week, 2 meaning it occurs several times a week, 3 manifesting itself daily, and 4 manifesting itself multiple times during the day.

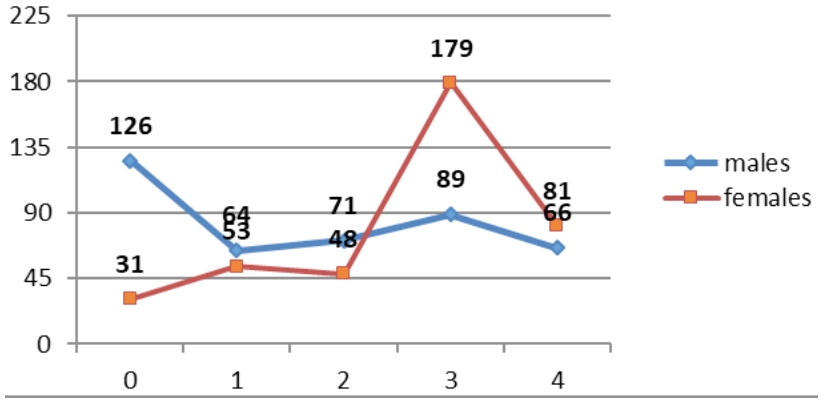

Figure 4. Comparison of stereotype movements regarding the gender

Figure 4 shows the comparison of total responses from the repetitive behaviour scale between girls and boys. There are a total of 15 female subjects with ASD and 16 male subjects. We can notice that male respondents have better answers compared to female respondents. Among the male respondents, the number with the smallest interval "0 - the stereotypic behaviour does not occur" is the largest, while among the females, the number of the high interval "3 - the behaviour occurs daily" is the largest.

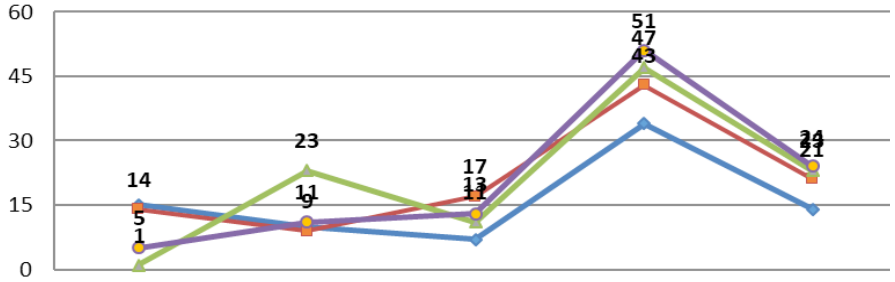

Figure 5. Age distribution of stereotypic movements in females

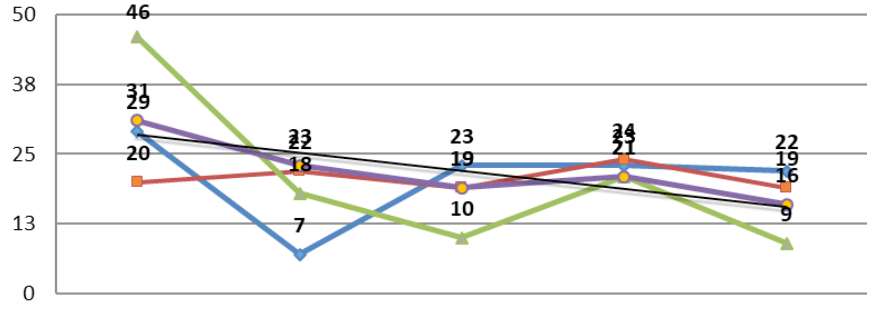

Figure 6. Age distribution of stereotypic movements in males

As previously stated, among girls, answers below 3 dominate in relation to stereotypical movements, that is, for the largest number, they appear daily (Figure 5). At the age of 5, in addition to the basic moving stereotypes of the nose, hands and fingers, stereotypic behaviour with objects is the most frequently encountered. At the age of 6, stereotyped movements with the hands and fingers dominate, at the age of seven, stereotyped movements during locomotion (swaying of the trunk, walking forward and backward, etc.) and stereotyped movements of the head. While at the age of eight, stereotyped self-injury type movements dominate (biting, hitting different parts of the body), and in relation to other activities, the most noticeable is the stereotypy in the game.

In male respondents at the age of 5, the prevalence of stereotypical movements with legs, hands and fingers is the same, and a fascination with the movements is observed. At the age of 6, stereotyped movements during locomotion are most often observed, at the age of seven, fascinations with movement and stereotyped activities are noted, i.e., movements aimed at satisfying sensory stimuli (smelling, licking, etc.). In the 8-year-old group, stereotyped movements of the hands and fingers, as well as stereotypes during locomotion, are observed (Figure 6).

The detailed analysis of the results indicates that the greater the deviations in the development of motor skills, the more pronounced the stereotypical behaviours and conversely, children who have a better coefficient of motor development have less pronounced stereotypical activities. With this, we would conclude that in children with an autistic spectrum disorder, better developed motility conditions a weaker manifestation of stereotypic behaviours. Unfortunately, we cannot say that motor skills improve with age and stereotypic behaviours decrease, because we can see that we have the best results, i.e., a higher coefficient of development of motor skills and a lower coefficient of stereotypic behaviours, while female respondents at the age of 8 have the weakest results, i.e., the lowest coefficient of motor skills and the highest stereotypic behaviours. The same can be said for male subjects with autism. Male subjects with autism at the age of 7 have the best results, that is, the best coefficient of development of motor skills, as well as the least pronounced stereotypic activities.

Discussion

In recent years, more and more emphasis has been placed on physical activities as a way of dealing with stereotypical movements and behaviours in children with ASD, in the direction of their reduction or purposeful use. In order to properly plan and implement physical exercises and activities, starting from the youngest age, it is necessary to make a detailed analysis of the motor development of children with an autistic spectrum disorder and determine the correlation between motor development and stereotypical movements and behaviour.

Research study provided by Uljarević et al. in 2017 replicates previous findings on the relationship between concurrent motor impairments and restricted and repetitive behaviours (RRBs), and provides the first evidence for the association between RRBs and age of attainment of early motor milestones, which highly correlates with our research.

A confirmation of the previous statements can be found in an another literature review study provided in 2021 by Lim et al., examining early motor function of children with autism spectrum disorder pointed out that in most of the studies early motor impairments were detected in children later diagnosed with ASD. The meta-analysis results indicated that differences in fine, gross, and generalized motor functions between the later ASD and typically developing groups increased with age. Motor function across different NDD groups was found to be mixed.

Similar to our research, in 2021 Andy et al. evaluated the association between physical exercise and stereotyped behaviour in children with autism. They found out that only hand-flapping stereotypic behaviours were significantly reduced in the ball-tapping exercise condition, whereas only body-rocking stereotypic behaviours were significantly reduced in the jogging exercise condition ($P < 0.017$).

Regarding the type of stereotypic movements and behaviours, our findings are in full correlation with the results of the research of Goldman et al. (2008) where it is confirmed that the frequency and severity of stereotypic movements and behaviours are greater in female respondents with autism compared to their peers with ASD of the opposite sex, as well as those without disabilities. The most common stereotypes and according to this research are stereotyped movements during walking (locomotion) and hand/finger stereotypes, followed by head/body stereotypes.

Conclusion

Clinicians and scientists have described motor skill differences since the earliest conceptualizations of autism, yet these differences are widely viewed as peripheral to the condition's core traits. Up to 87 percent of autistic children exhibit motor challenges, yet only a small number receive a motor-specific diagnosis (15 percent) or treatment (32 percent), revealing a considerable clinical gap. Based on these findings, motor challenges are at least as prevalent in people with autism as either cognitive or language impairment, which are both DSM specifiers and widely thought to shape individual presentations, treatment recommendations and outcomes (De Marchena & Zampella, 2022).

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КОРЕЛАЦИЈА ПОМЕЃУ СТЕРЕОТИПНИТЕ МОТОРНИ ДВИЖЕЊА И МОТОРНИОТ РАЗВОЈ КАЈ ДЕЦА СО АУТИЗАМ

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Резиме

Иако аутистичниот спектар на нарушување (АСН) е честа тема на истражување, сепак има многу несигурности и работи кои треба да се откријат, со цел правилно да се планира и спроведе третманот и да се овозможи максимална функционална независност.

Имајќи предвид дека повеќето студии се однесуваат на проценка на однесувањето, социјалната интеракција, етиологијата на нарушувањето на аутистичниот спектар, главната цел на нашето истражување беше да се утврди постоењето на корелација помеѓу моторниот развој и степенот на стереотипни моторни движења кај децата со АСН. Во истражувањето беше вклучен примерок составен од 31 дете со АСН на возраст од 5 до 8 години, а за добивање на потребните информации беа користени скала за проценка на груба моторика, скала за проценка на фина моторика и скала за проценка на стереотипни однесување.

Според добиените резултати, можеме да заклучиме дека има големи отстапувања во моторниот развој на децата со АСН, како кај грубата, така и кај фината моторика. Колку се поизразени стереотипните движења, толку се поголеми отстапувањата во моторниот развој и обратно, децата кои имаат подобар коефициент на моторен развој имаат помалку изразени стереотипни активности.

Раните моторни оштетувања се евидентни кај децата со АСН, особено кај оние подоцна дијагностицирани со АСН. Потребни се повеќе истражувања за да се утврди клиничката корист од откривањето на моторните оштетувања како ран трансдијагностички маркер за ризикот од невроразвојни растројства. Нашиот став е дека раната стимулација и третман на моторни нарушувања ќе доведе до намалена фреквенција на стереотипни движења и подобра функционалност.

Клучни зборови: *нарушување на аутистичниот спектар, стереотипни движења, моторен развој.*