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MOTOR IMPAIRMENT IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDERS - A THEORETICAL APPROACH

DANCIU RĂZVAN CONSTANTIN[1], MARINESCU GHEORGHE [1], TICALĂ LAURENŢIU DANIEL[1]

Abstract

Aim. The purpose of this theoretical research is to collect information from different studies and literature review; different studies that involved children with autism and their physical fitness / physical activity participation and make a comparison between them. This research also aims to identify the motor impairments in individuals with autism and to fill the gap of knowledge of the possible role and contribution attributed by a physical therapist in the rehabilitation process.

Methods. This retrospective study collected and analyzed data from 20 different studys and reports. Data were obtained by disseminating and analyzing the results performed by numerous specialists in the autistic field.

Results. The study highlighted strong correlations between motor impairment and children with autism.For Test of Gross Motor Development 73% of participants with autism were found to have delayed fundamental motor skills, placing them in the poor or very poor category of ability (Staples, Reid, 2009).Other researchers concluded that persons with autism show deficits in movement preparation, rather than execution. Muller et all (Karen, Ross , Jessica, Gina Allen, Eric, 2001) evidence in their studies atypical cortical activation, during the performance of simple visually paced finger movements, by eight adolescents with autism, compared with normal controls. Individuals with autism showed greater variability in their motor responses. We will present extensively all the research.

Conclusions. A growing body of evidence recorded by researchers have shown that motor impairment are clearly common in individuals with autism. Different patterns of motor differences may be associated with subgroups on the autistic spectrum disorder. Neuroimaging techniques are also opening up avenues for further research in this field. Research needs to explain if an interruption of one or more fundamental processes, leads to a cascade of developmentalconsequences.

*Keywords:*autism, motor impairment, physical activity.

Introduction

Autism spectrum disorder is a complex neurobiological condition that impacts brain development and affects a person´s social relationships, communication, interests and behavior (https://autismawarenesscentre.com/what-is-autism-spectrum-disorder). The symptoms and characteristics appear in a wide variety of combination, individuals can exhibit any combination of the behaviors in any degree of severity. Studies indicate that autism spectrum disorder affects one in every 68 children and the prevalence is constantly rising (https://www.innerbody.com/diseases-conditions/autism-spectrum-disorder). Autism usually appears early in life, often before the age of three, and is four to five times more common in boys than in girls. Autism emerges everywhere. It is not associated with a certain ethnicity, geographic area, social or economic level. Individuals with autism spectrum disorder tend to have difficulties communicating. Their communication challenges can range from being non-verbal to responding inappropriately in conversation, to not understanding non-verbal cues, or having difficulties building friendships appropriate to their age. In addition, individuals with autism may be overly dependent on routines, highly sensitive to changes in their environment, or intensely focused on inappropriate items. Many people with autism have a great deal of difficulty communicating through both verbal and non-verbal means. Even if a person with autism has a high level of speech they will use it to talk "at you" on their own terms, about their own interests. They may be unable to talk about their own thoughts and emotions. They will often not be able to understand abstract concepts, gestures, facial expressions or tone of voice; they may use gestures themselves, which can seem odd or inappropriate (http://www.autismtoolbox.co.uk/understanding-autism/social-imagination). People with autism often experience difficulty with activities involving imagination

[1] National University of Physical Education and Sports,140 Constantin Noica Street, Bucharest, Romania
Corresponding author: razvan.physio@yahoo.com

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(https://planetautismblog.wordpress.com/2018/01/02/autistic-imagination); this is characterized by a rigidity and inflexibility, which may cause problems during activities such as playing with another child or concepts such as empathy. They often focus on trivial or inappropriate objects around them, and may show an obsession (https://www.autism.org.uk/about/behaviour/obsessions-repetitive-routines.aspx) for objects or certain rituals or routines, or they may appear unaware of danger. Some children with autism have low muscle tone, some have poor balance, other may not well-coordinated, and still others may have a combination of all of the above (https://www.autism.org/advice-for-parents).

The causes of autism are still largely unknown. The researchers know that it is not caused by parents or the way a child is raised, and there is likely no single cause. Research is underway to explore possible causes including genetic and environmental factors. There is no cure for autism spectrum disorder; there are, however, highly effective treatment and intervention methods available that can help individuals and their families address the characteristics of this disorder (http://www.jneuro.com/neurology-neuroscience/assessment-of-autonomic-function-in-children-with-autism-and-normal-children-using-spectral-analysis-and-posture-entrainment-a-pilot-study.php?aid=7297). Early intervention based on best practices are intended to help children with autism develop skills, learn to communicate effectively, share in family life and enjoy success in school.

The nervous system is the organizer of everything so that when we make changes here, they are systemic changes that the child can begin to make use of right away in all aspects of their daily lives. This translates into changes in movement, in fine motor control and in speech, as well as in the child's overall behavior and approach to problem solving.

Because movement is a language the brain understand small, gentle movements can be used to form millions new connection in the brain (https://www.brainfacts.org/thinking-sensing-and-behaving/movement). These new connections bring with them an increased sense of awareness and ease; these sense of ease is critical from a learning standpoint.

Every child profits from exercise if it is fun. Every child needs exercise, and children with autism are no exception; in fact, physical exercise can have additional behavioral benefits if certain precaution and techniques are used. All the usual gross motor activities of running, walking, jumping, cycling and others can be engaged in and enjoyed by children with autism.

Because children with autism relate to their environment differently (https://autism.lovetoknow.com/Environment_for_Autistic_Children) than other children, engaging in physical activity in an environment they are not used to can be scary to them. For instance, wide-open spaces might be disorienting, and loud noises , quite common in a qym can startle autistic children. As a result a child with autism might display behaviors like toe walking (https://www.mayoclinic.org/diseases-conditions/toe-walking/symptoms-causes/syc-20378410), flapping hands or angry outbursts, among other thing, in these environments.

Methods

For the elaboration of this research I consulted the specialized literature from 20 different studys and reports. The collected data wanted to make arguments and bring evidence releating to motor impairment in individuals with autism spectrum disorder. We made a comparassion between this studies theat were carried out over time. Researchers have conducted the studies using different types of tests like Movement Assessment Battery for Children, Test of Motor Impairment – Henderson Revision and the Bruininks-Oseretsky test. The results will be presented in extensor below.

Results

In a study by Staples and Reid (Staples, Reid, 2009) the performance on the Test of Gross Motor Development of 9 to 12 year old children with ASD was compared to three groups of typically developing children matched on chronological age, movement skill, or cognitive ability. Children with ASD performed similarly on locomotor and object control subtests, demonstrating significant delays relative to their chronological age and majority performing similar to children approximately half their age (4 to 6 years). These movement skill impairments were also greater than would be expected given their cognitive level.

The findings of by Pan, Tsai, and Chu (Pan, Tsai, Chu, 2009) also found significant groupdifferences based on performance of both locomotor and object control skills between 6 to 10 year old boys with ASD and their typically developing peers of similar age. This study also conducted separate analyses to examine the performance of individual skills in the Test of Gross Motor Development; results demonstrated that children with ASD had particular difficulty with two locomotor (gallop and hop) and four object control (strike, dribble, catch, roll)skills.

A study by Hiton, Wente, LaVesser, Ito,

Reed and Herzberg (Hilton, Wente, LaVesser, Ito, Reed & Herzberg, 2007) examined the correlation between severity of Asperger's Syndrome and motor impairment. Children with Asperger Syndrome (AS) aged 6-12 years of age (n=51) and a control group of typically developed children also aged 6-12 years (n=56), were assessed using the Social Responsiveness Scale (SRS) and the Movement Assessment Battery for Children (MABC). A bivariate correlational design was used to compare the scores, with a Spearman rank correlational coefficient. Significant differences were seen between typical, mild to moderate and severe categories of SRS scores. This was based on a Kruskal-Wallis one-way analysis of variance by ranks ($p< 0.05$). Strong correlations were found between the MABC motor impairment scores and the SRS severity levels. The researchers concluded that the degree of correlation indicated that motor skill impairment is a function of severity within SRS, for children with AS. This is useful in terms of programme planning for children with AS. Research involving other subtypes on the autistic spectrum is necessary to establish if this finding is confined to those with AS. The researchers in this study state that intervention programmes addressing motor impairments of those with AS, would add depth to thisfinding.

In the research of Berkley, Zittel, Pitney & Nichols (Berkeley, Zittel., Pitney and Nichols 2001), the skills of fifteen children (10 male, 5 female) with high functioning autism were compared to national scores in the Test of Gross Motor Development (TGMD) 73% of participants were found to have delayed fundamental motor skills, placing them in the poor or very poor category of ability. The effect size for all participants denoted large differences. Eighty percent of the children were placed in the poor category for locomotor skills. In assessing object control, 53% were placed in the poor category. The boys scored higher than the girls in all categories. The researchers felt that the TGMD was very appropriate as an assessment tool, as it was of relatively short duration, with few pieces of equipment, keeping distractions to a minimum. However, they did indicate that the children had difficulty interpreting the locomotor tasks and many focussed on the end result i.e. getting from A to B rather than performing the actual skill requested i.e. run, skip orhop.

In the research of Manjiviona & Prior (Manjiviona, Prior 1995) motor skills of children with high functioning autism (HFA), were compared with that of children with Asperger's Syndrome (AS). A total of 21 subjects participated in the study, 12 children had Asperger's syndrome and the remaining 9 children had high functioning autism. Motor skills were measured using the Test of Motor Impairment – Henderson Revision (TOMI-H, 1984). The children selected had IQ in the normal or near normal range, to facilitate comparisons between the AS and HFA groups. Findings indicated that 50% of the children with Asperger's syndrome and 66.7% of the children with high functioning autism had definite motor problems. The TOMI-H was a suitable test item, as tasks were clearly defined. The study clearly indicates that motor impair mentis a commonality to those individuals on the overall autistic spectrum and warrants further investigation and intervention studies. Limitations identified in this study were the lack of diagnostic separation of the HFA and AS groups in their original diagnosis and selection. Some of the subjects could meet diagnostic criteria for both disorders.

A comparative examination of 'clumsiness' in autism, Asperger's syndrome (AS) and Pervasive Developmental Disorder not otherwise specified (PDD-NOS) by Ghaziuddin and Butler, found coordination deficits in all three groups. Children with AS (n=12) were found to be less impaired than those with autism (n=12) and PDDNOS (n=12). The Bruininks-Oseretsky test (Bruininks,) was used to assess motor coordination. In this sample the mean full-scale IQ of the AS group, was significantly greater than that of the other two groups. When the data were analysed adjusting for the full scale IQ, no significant differences were found in the mean coordination test scores, for the three groups. These findings indicate that the children with AS may have less motor impairment than the other groups, due to their higher level of intelligence. The researchers in this study question the validity of the Bruininks-Oseretsky test, as it did not provide any information on the 'pattern' of deficits. They further question the test validity as it was based on timing of skills, which does not allow for quantifying subtle changes in motorperformance.

In a study designed to clarify neuropsychological distinctions between Asperger Syndrome (AS) and High Functioning Autism (HFA), Miller and Ozonoff (Miller , Ozonoff, 2000) tested 40 children with Autistic Spectrum Disorder (ASD) aged between 6-13 years. All participants had IQ s above 70. Participants with AS (n=14), had intact early language and never met criteria for autism. The remaining participants met the criteria for HFA (n=26). The children's motor abilities were assessed using the Movement Assessment Battery for Children . Results indicated that only the manual dexterity subscore differentiated the AS and HFA groups, with

children with AS showing more impairment. This result was obtained when IQ scores were covaried in the analysis. Test results were supplemented by parental reports. Sixty six percent of parents of children with AS reported their children were "clumsy." A further 85% of parents of children with HFA reported similar findings. The researchers repeated their analyses with subgroups of their sample, matched on IQ and found the pattern of results were unchanged. Miller and Ozonoff concluded that there is little evidence that AS is neurologically distinct from HFA. With reference to motor skills, they noted that their results showed some tendency to weaker performance, specific to fine motor skills for children with AS when IQ differences arecontrolled.

In earlier research, Morin & Reid (Morin & Reid 1985) examined whether delayed motor development was due to autism or learning disability. The two groups used were boys, one with autism (n=8) and the other group with learning disabilities (n=8) only. The groups were matched closely on chronological age and measured intelligence. Qualitative and quantitative scores for balance, catching, standing long jump were assessed using test items adapted from the Bruininks-Oseretsky Test of Motor Proficiency and running and throwing were assessed using test items adapted. The boys with autism were also assessed, on the relationship between qualitative performance on the formal test items and the quality of motor patterns, elicited during guided play. The adolescents with autismreceivedsignificantlyinferiorqualitativescores ,comparedtotheadolescentswith learning disabilities, on throwing, jumping and running tasks. No differences were found between the groups, on qualitative and quantitative measures on ball catching skills. Findings indicated that the group with autism had better balance than the group with learning disabilities, but they moved at a slower more controlled pace than those with learning disabilities. Morin and Reid suggested that participants with autism might not have performed as well quantitatively, if the tasks were more difficult. Morin and Reid concluded that delayed motor function in low functioning individuals with autism, might be more reflective of accompanying learning disabilities than autism, which poses great concerns for practitioners in the field. This finding has major implications in programme planning, as characteristics of both autism and learning disabilities must be considered and programmes implemented and evaluated from both perspectives (Report of the Special Education Review Committee, 1993).

Research by Schleinen, Heyne & Berken (Schleien, Heyne, Berken, 1988) examined the development of motor skills and social skills in children with autism, when paired with typically developed peers as gym partners, using an adapted physical education/ therapeutic recreation curriculum. Six children with autism aged between 4-12 years, participated with 50 typically developed peers in a 9-week, twice weekly physical education class in a primary school. All participants received training, which included a variety of lifelong recreation and physical education activities designed to teach social skills and fundamental motor skills. Social Play was observed in groups, with 3 participants observed during each assessment. The participants were presented with five activities one at a time, beginning with the isolate play level and ending with the team level. An observation- record procedure was used. The motor assessment instrument was a task analysed criterion-referenced checklist in which performance to the required task was evaluated. Paired t tests were used. Results indicated significant reductions in inappropriate play behaviour for the younger group at parallel and cooperative/ competitive and social levels of play. No other findings attained statistical significance. Further observations indicated increased involvement in the activities by the participants with reduced inappropriate play behaviour, reduced target inappropriate behaviours and improved motor proficiency in catching and striking skills. The authors predicted had the programme been ran for a longer period of time greater improvements would have been noted. Limitations indicate that programmes of longer duration and greater frequency may have yielded greater results. The subjective nature of the assessment instruments used may be considered limiting. This study has potential, in that it promotes the need to further investigate efficacy of physical activity programmes, for both motor and social development for children with autism. Children with autism playing alongside their typically developed peers showing improvements in motor proficiency and reductions in inappropriate target and play behaviours is of great importance to programme planners. Using the concepts of 'circle of friends', 'Buddy Systems' and reverse mainstreaming has potential to enhance these findings in a variety of settings, thus providing children with autism with greater opportunities to meaningfully interact with their typically developed peers (Howlin, Rutter, 1987). As outlined in the evaluation of autism provision, this interaction is also of benefit to the typically developed child to learn acceptance for those with a disability .This research needs to be explored further in a variety of

settings and with different age groups.

Much of the previous research has concentrated on individuals with AS or HTA. Research on children with autism who are not high functioning, is not as readily available.

Hauck and Dewey (Joy, Deborah, 2001) examined the relationship between hand preference and autism. The researchers sought to examine findings on inconsistency of hand preference of children with autism. Twenty children diagnosed with autism, aged 2 –7 years participated in the study. Two control groups matched on mental age were used. The first group consisted of children with non-specific developmental delays, who were matched on chronological age, to the children with autism. The typically developed children in the second control group were on average 8 months younger on chronological age, than the children with autism. The Motor Domain of the Battelle Development Inventory was used yielding age equivalent scores, for fine and gross motor skills. The results confirmed that inconsistency of handedness is observed more frequently in children with autism, than in matched children with developmental delay. The fine and gross motor skills of the children with developmental delay were significantly higher, than that of the typically developed children in the control. Neither the fine nor gross motor skills of the children with autism differed significantly from that of either control. Analysis of trends showed that children with autism who had not developed a hand preference, showed relatively poor fine motor skills. The researchers concluded that there is a complex relationship between the development of hand preference and motor skill in autism that is unlike that observed in other children with developmental delays. This research raises questions about the developmental course of motor skill acquisition for this population that warrants furtherinvestigation.

A further study of interest in relation to motor skills and autism was that conducted by Rinehart, Bradshaw, Brereton and Tonge (Rinehart, Bradshaw, Brereton, Tonge, 2001). The researchers sought to examine whether motor dysfunction in autism was due to deficits in motor execution, or motor planning. A group of children and adolescents aged 5-19 years old with AS (n=12) and HFA (n=11) participated. Each group was matched to a typically developed control group on gender, age and IQ. A motor reprogramming task was used to examine the preparation and execution of movements. The tasks required participants to alternate between left and right buttons, in response to a light cue at the base of each button. On "oddball" trials the participants had to move to an alternative button, unexpectedly. Results indicated that speed of motor execution was consistent, throughout all groups. However both AS and HFA groups differed from controls, on movement preparation parameters. Children with HFA showed fast movement preparation across trials and were unaffected by the oddball trial. Controls were slower to prepare pre oddball movements, but responded faster on the trials immediately following the oddball trial. However, participants with AS were slower than their controls to prepare the first movement following oddball trials, thus demonstrating a response time cost, where controls showed a benefit. The researchers concluded that high functioning persons with autism show deficits in movement preparation, rather than execution. The differences in HFA and AS, in the pattern of impaired movement preparation were interpreted as evidence of different neuropsychological mechanisms, operating in both HFA and AS. Clearly this is an area that warrants further investigation. Research should ideally be conducted with control groups with motor impairments, to clearly isolate the relationship between motor dysfunction andautism.

A further area of research is that of using functional magnetic resonance imaging studies (MRI), to explore whether individuals with autism show different patterns of localised neural activation, during motor tasks.

Findings of Muller, Pierce, Ambrose, Allen and Courchesne (Müller, Pierce, Ambrose, Allen , Courchesne, 2001) include evidence of atypical cortical activation, during the performance of simple visually paced finger movements, by eight adolescents with autism, compared with normal controls. Individuals with autism showed greater variability in their motor responses. Muller et al. interpreted these findings as indicative of abnormalities of both anatomy and functioning of the cerebellum and related structures in individuals with autism. These developments, in establishing underlying neurological abnormalities that may give rise to atypical motor performance in individuals with autism, are verypositive.

Conclusions

Motor skills are extremely useful for learning skills in other areas (social behaviors, communication skills, academic engagement and sensory skills) and thus motor-related difficulties should be addressed as a core discipline within the educational curricula or through related therapy services during early childhood. The results of this study demonstrate that children with autism have atypical motor achievements and motor impairment. Motor impairment and motor delays which are mostly overlooked have been identified in children with autism and might escalate with

progressive age, regress into a set of chronic disorders, and could become increasingly pervasive with age. Dealing with individuals with autism is definitely a challenging task ; physical therapists can, and should promote interventions appropriate of enhancing the motor activity of individuals with autism in a meaningful and functional way.

Aside from the obvious benefits of physical activity, there are several health related benefits that go beyond improving physical strength and endurance, and preventing chronic disease. Physical activity has been shown to improve phycological wellbeing (McPhail, 2006) and physical activity level have an undisputed effect on feelings of quality of life and overall satisfaction. Physical activity also has direct implications with children in matter of self-determination (Reid, O"Conner, 2003), strength, self-esteem, body-image and stress reduction (Poulsen, Ziviani, 2004). General positive affect and mood have been consistently associated with physical activities (Biddle, Mutrie, 2001) which has also been noted to help prevent anxiety and depression (Russell, Newton, 2008).

Abbreviations and symbols

Test of Gross Motor Development (TGMD), Autism Spectrum Disorder (ASD), Asperger Syndrome (AS), HFA (High Functioning Autism),Pervasive Developmental Disorder not otherwise specified (PDD-NOS), Social Responsiveness Scale (SRS) , Movement Assessment Battery for Children (MABC), Test of Motor Impairment – Henderson Revision (TOMI-H, 1984).

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