Med. J. Cairo Univ., Vol. 87, No. 4, June: 2257-2260, 2019
www.medicaljournalofcairouniversity.net

Relationship between Upper Limb Co-Ordination and Severity Level in Children with Autism Spectrum Disorder

SAMAH ATTIA EL-SHEMY, Ph.D.* and MOHAMED SALAH EL-SAYED, M.Sc.**

The Department of Physical Therapy for Paediatrics, Faculty of Physical Therapy, Cairo and Horus (HUE)** Universities*

Abstract

Background: Autism is a multisystem neurodevelopmental disturbance characterized by stereotyped behaviors, restricted interests, as well as impaired communication and social interactions.

Aim of Study: The current study examined the relationship between upper limb coordination, as measured by Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition (BOT-2), and autism severity, as measured by the Childhood Autism Rating Scale (CARS).

Subjects and Methods: Thirty (30) children with a diagnosis of Autism Spectrum Disorder (ASD) were evaluated using the CARS and then tested for upper limb coordination using (BOT-2), Statistical analysis was then conducted to examine the relationship between autism severity and upper limb coordination.

Results: The results of the present study showed that there was a negative correlation between CARS score and upper limb after adjustment for age, weight, height, gender and year of birth.

Conclusion: Evidence suggests that upper limb coordination in children with ASD is related to the severity of the disorder. Further research is needed to determine the extent and consistency of the motor impairments and possible treatments.

Key Words: *Autism spectrum disorder – Childhood Autism Rating Scale – Bruininks-Oseretsky Test of Motor Proficiency – Motor impairment.*

Introduction

IN recent years concern has risen about the increasing prevalence of neurodevelopmental disorders. A striking example is Autism Spectrum Disorders (ASD). This condition is reported to affect 1 in 68 children [1]. Autism spectrum disorder is a condition defined by its core features [2]. The diagnostic and statistical manual of mental disorders, fourth edition, text-revised (DSM-IV-TR), published by the American Psychiatric Association for the classification of mental disorders, is used to diagnose the autistic disorder. The DSM-IV-TR criteria for autistic disorder includes: Qualitative impairment in social interaction, qualitative impairments in communication and restricted repetitive and stereotyped patterns of behaviour, interests, and activities. Although ASD is considered a psychiatric disorder, other features, more physical or systemic in nature, are associated with autism.

It is characterized by a range of social and communicative impairments as well as repetitive behaviours. Although language, social, and cognitive differences are characteristics of ASD, motor difficulties have also been noted [3]. Motor impairment is not a part of the diagnostic criteria for children with ASD, however, the abundance of research literature reporting significant delays in gross and fine motor skill performance [4-6].

Some autistic children are well coordinated, but others have varied motor deficits. Previous researches has identified deficits in coordination and general motor function [7], and the planning and execution of movement in children with ASD. The motor development of toddlers and preschool age children with ASD has emerged as an area of interest due, in part, to the increased need for early diagnosis and the increasing evidence that children with ASD exhibit atypical motor characteristics [8]. Early detection of motor developmental disorders in autism spectrum disorders children will be of greater value for critical intervention of developmental delay.

Studies that examined balance, coordination, movement or motor planning, and fine and gross motor skills in ASD, found problems in those areas. Although research is limited, anecdotal reports

Correspondence to: Dr. Samah Attia El-Shemy,
The Department of Physical Therapy for Paediatrics,
Faculty of Physical Therapy, Cairo University

suggest that some children with autism have lower muscle strength as compared to typically developing children [9,10]. It remains unclear how important muscle weakness is in autism and how muscle-strength may contribute to the movement, balance, and coordination problems. Furthermore, no studies have examined the relationship between upper limb coordination and autism severity. The current study examines the relationship between upper limb coordination as measured by Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition [11] and autism severity as measured by the Childhood Autism Rating Scale (CARS) [12].

Subjects and Methods

The present study carried out in the duration from November 2017 till April 2018, included thirty autistic children of both sexes; they were recruited from institutes of handicapped children and schools of special needs and some private clinics in Mansoura city.

Study design:

This study used a bivariate correlational research design (pearson rank correlational coefficient). It examined the relationship between autism severity and motor impairment in children between age 8 and 10 years. Descriptive statistics were used to describe the motor impairment levels and severity. Research procedures to assure the safety and privacy of the subjects and to prevent unnecessary risk for them were included as part of this study in accordance with Institutional Review Board Protocol.

Subjects:

Children with a diagnosis of ASD were recruited from the community to participate in the study. After explaining the study and obtaining informed consent from the parent(s), each child was evaluated using the CARS [12], and then tested for upper limb coordination subtest of Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition [11]. Statistical analysis was then conducted to examine the relationship between autism severity and upper limb coordination. Thirty children with autism their age was ranged from 8-10 years, who were full-term, had an overall IQ of at least 70, had no history of cerebral palsy or any other diagnosed major neurological condition, had no history of hearing problems, and had no hearing or sight problems that were not correctible. Diagnostic categories were based on physician diagnosis per parent report on the data form and confirmed by the DSM-IV-TR [2].

None of the study participants had any change in therapy or treatment (including medications) within one month prior to the study in order to limit possible confounding factors, such as problems from medication changes. None of the study participants had previously received carnitine-based therapy or previous methionine or lysine supplementation. This study was designed to exclude children who had a history of Fragile X disorder, tuberous sclerosis, phenylketonuria (PKU), Lesch-Nyhan syndrome, seizure disorder, cerebral palsy, fetal alcohol syndrome, or any history of maternal illicit drug use. Detailed information was collected on each participant regarding age, gender, weight, height and year of birth. Table (1) summarizes the demographic information for the subjects examined in the present study.

Assessment measures:

1- Childhood Autism Rating Scale (CARS):

Study participants were evaluated using a CARS test conducted only by a single study investigator who observed the participants and interviewed the parent(s). The CARS was completed just prior to upper limb coordination testing.

The CARS test is a 15-item behavioural rating scale developed to identify autism as well as to quantitatively describe the severity of the disorder [12]. For CARS evaluation, a total score of about 25 is considered to be the minimum cut-off for an ASD diagnosis [13]. The CARS is a well-established measure of autism severity. The internal consistency reliability alpha coefficient is 0.94; the inter-rater reliability correlation coefficient is 0.71; and the test-retest correlation coefficient is .88. CARS scores have high criterion-related validity when compared to clinical ratings during the same diagnostic sessions, with a significant correlation of 0.84 [12].

2- Bruininks-Oseretsky test of motor proficiency-2nd edition (BOT-2):

BOT-2 is a reliable and valid measure of fine and gross motor performance in individuals between 4 and 21 years of age [11]. We used upper limb coordination subtest to assess motor performance in the children. We are reporting scale scores for the upper limb coordination subtest.

Data analysis procedures:

All data were analysed using SPSS for Windows, Version 23. Data cleaning and validation were completed prior to data analysis. Scatter plot analyses were undertaken for each set of data to examine for the presence of a linear relationship

and for data entry error. Data entry errors were corrected using verification from original data forms. A descriptive analysis of the demographic data was completed on the aggregate of the subjects including the frequencies of gender, age, weight, and height. Pearson correlation coefficient analysis was used to examine the correlation between the severity levels and motor impairment levels.

Results

The results of the present study showed that there is a negative correlation between CARS score and upper limb coordination indicated that CARS score is a significant predictor of upper limb coordination level (r=–0.41 1 & p=0.024) after adjustment for age, gender, height and year of birth.

Table (1): General characteristics of the participants.

	Demographic data				
	Age (years)	Weight (kg)	Height (cm)	Gender** (number and frequency)	
				Male	Female
Mean ± SD*	9.34± 0.60	12.0± 1.38	135.15± 4.90	20 (66.66%)	10 (33.33%)

* : Data are expressed as mean ± SD.
**: Data are expressed as number and frequency.

Table (2): Correlation between difference in CARS score and upper limb coordination.

	Upper limb coordination subtest	CARS Score
Mean ± SD	2.43±2.30	34.50±5.50
r-value	–0.411	
p-value	0.024*	

r: Pearson correlation coefficient.
*: p<0.05 = Significant.

Discussion

The more severely affected a child with ASD was, the weaker the child's upper limb coordination. The apparent relationship between autism severity and upper limb coordination has interesting implications. First, it suggests that ASD may not be just a mental disorder, but a medical condition that may also include physical disability. Studies in ASD suggest a motor coordination component, impairments in motor development, hypotonia, and poor sensory-motor functioning in ASD **[8-10, 14-16]**.

A second implication from the apparent relationship between autism severity and upper limb coordination is that treatments in autism may need to address the physical or medical disabilities **[17]**.

The relationship between the upper limb coordination and the autism severity level indicates that motor impairment is related to severity in ASD and has significant importance for understanding the neurobiology of ASD.

Recruitment of a larger number of subjects with mild to moderate severity for future examination would help to substantiate the lack of differentiation between the motor skill impairment levels of mild to moderately severe and severe subjects. Replication of this study in a larger and more ethnically and geographically diverse population would help to strengthen the results of this study and to examine for ethnic differences in motor impairment.

Further expansion of the underlying causes of motor impairment in children with ASS would also add an important dimension to what is currently known about motor impairments. Another valuable direction of inquiry would be to examine the relationship between motor skills and participation patterns by these children. This would allow better understanding and interpretation of the findings from this study regarding the relative value of motor skills for actual participation **[18]**.

The impact of various interventions addressing the motor performance with children who have ASD would add depth to the understanding of this group. Examination of other factors correlated with the presence or lack of motor impairment could expand our understanding of this complex condition.

Limitation:

This study was limited by small sample size due to time bounded study. However, measuring upper limb coordination using BOT-2 in children with autism is more difficult because their level of awareness and ability to cooperate can present as confounding factors. How much the child's ability to follow directions and willingness to cooperate contributed to the variability is unknown.

Conclusion:

This current study suggests that upper limb coordination in children with ASD was related to the severity of the disorder. There is a paucity of research that examines motor impairment in ASD and possible underlying reasons. Conceivably, motor impairment contributes to other physical limitations, such as the movement, balance, and coordination problems. Understanding the extent of each child's muscle weakness, may provide more insight into the child's physical limitations and plan of care.

References

1- Developmental, Disabilities Monitoring Network Surveillance Year, and 2010 Principal Investigators. "Prevalence of autism spectrum disorder among children aged 8 years-autism and developmental disabilities monitoring network, 11 sites, United States, 2010". Morbidity and mortality weekly report. Surveillance summaries (Washington, DC: 2002) 63 (2014): 1.

2- American Psychiatric Association: Diagnostic criteria for autistic disorder. Diagnostic and statistical manual of mental disorders fourth edition-text revision (DSM-IV-TR), Washington, DC: American Psychiatric Association, 2000.

3- BHAT A.N., LANDA R.J. and GALLOWAY J.C.: Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. Physical Therapy, 91 (7): 1116-29, 2011.

4- OZONOFF S., HEUNG K., BYRD R., HANSEN R. and HERTZ-PICCIOTTO I.: The onset of autism: Patterns of symptom emergence in the first years of life. Autism. Res., 1 (6): 320-8, 2008.

5- WHYATT C.P. and CRAIG C.M.: Motor skills in children aged 7-10 years, diagnosed with autism spectrum disorder. J. Autism. Dev. Disord., 42: 1799-809, 2012.

6- LIU T., HAMILTON M., DAVIS L. and ELGARHY S.: Gross motor performance by children with autism spectrum disorder and typically developing children on TGMD-2. Journal of Child and Adolescent Behaviour, 2: 123, 2014.

7- JANSIEWICZ E.M., GOLDBERG M.C., NEWSCHAFFER C.J., DENCKLA M.B., LANDA R. and MOSTOFSKY S.H.: Motor signs distinguish children with high functioning autism and Asperger's syndrome from controls. Journal of Autism and Developmental Disorders, 36 (5): 613-21, 2006.

8- PROVOST B., LOPEZ B.R. and HEIMERL S.: A comparison of motor delays in young children: Autism spectrum disorder, developmental delay, and developmental concerns. J. Autism. Dev. Disord., Feb., 37 (2): 321-8, 2007.

9- MING X., BRIMACOMBE M. and WAGNER G.C.: Prevalence of motor impairment in autism spectrum disorders. Brain & Development, 29: 565-70, 2007.

10- MINSHEW N.J., SUNG K., JONES B.L. and FURMAN J.M.: Underdevelopment of the postural control system in autism. Neurology, 63: 2056-61, 2004.

11- BRUININKS R.H. and BRUININKS B.D.: Bruininks-Oseretsky Test of Motor Proficiency Manual, 2 nd ed., Minneopolis: NCS PearsonInc, 2005.

12- SCHOPLER E., REICHLER R.J. and RENNER B.R.: The Childhood Autism Rating Scale (CARS). Los Angeles: Western Psychological Services, 1988.

13- CHLEBOWSKI C., GREEN J.A., BARTON M.L. and FEIN D.: Using the Childhood Autism Rating Scale to diagnose autism spectrum disorders. Journal of Autism & Developmental Disorder, 40: 787-99, 2010.

14- GREEN D., CHARMAN T., PICKLES A., CHANDLER S., LOUCAS T., SIMONOFF E. and BAIRD G.: Impairment in movement skills of children with autistic spectrum disorders. Developmental Medicine & Child Neurology, 51: 311-6, 2009.

15- HARDAN A.Y., KILPATRICK M., KESHAVAN M.S. and MINSHEW N.J.: Motor performance and anatomic Magnetic Resonance Imaging (MRI) of the basal ganglia in autism. Journal of Child Neurology, 18: 317-24, 2003.

16- MOSTOFSKY S.H., POWELL S.K., SIMMONDS D.J., GOLDBERG M.C., CAFFO B. and PEKAR J.J.: Decreased connectivity and cerebellar activity in autism during motor task performance. Brain, 132 (Pt 9): 2413-25, 2009.

17- PIEK J.P. and DYCK M.J.: Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder. Human Movement Science, 23: 475-88, 2004.

18- HILTON C., WENTE L., LaVESSER P., ITO M., REED C. and HERZBERG G.: Relationship between motor skill impairment and severity in children with Asperger syndrome. Research in Autism Spectrum Disorders, 1: 339-49, 2007.

العلاقة بين تآزر الطرف العلوى ومستوى الخطورة لدى الآطفال الذين يعانون من إضطراب طيف التوحد

درست الدراسة الحالية العلاقة بين التآزر بين الآطراف العليا، والتى تم قياسها من خلال إختبار Bruininks-Oseretsky الإصدار الثانى (BOT-2)، وشدة التوحد، وفقا لمقياس تقييم التوحد للطفولة (CARS). تم تقييم ثلاثين (٣٠) طفلا مع تشخيص إضطراب طيف التوحد (ASD) بإستخدام CARS ثم تم إختبارهم لتآزر الآطراف العليا بإستخدام (BOT-2)، ثم تم إجراء التحليل الإحصائى لفحص العلاقة بين شدة التوحد والتنسيق بين الآطراف العلوية. آظهرت نتائج الدراسة الحالية وجود إرتباط سلبى بين درجة CARS والجزء العلوى بعد التعديل بالنسبة للعمر والوزن والطول والجنس وسنة الميلاد. تشير الدلائل إلى آن التآزر فى الآطراف العليا فى الآطفال المصابين بالتوحد يرتبط بحدة الإضطراب. هناك حاجة إلى مزيد من البحث لتحديد مدى وإتساق العاهات الحركية والعلاجات الممكنة.