

Evaluation of motor aspects performance in children with autistic spectrum disorder in Amazon reference institutions

Avaliação de aspectos do desempenho motor de crianças com transtorno do espectro autista em instituições de referência no interior da Amazônia

Silvania Yukiko Lins Takanashi¹
<https://orcid.org/0000-0002-6410-7160>

Zizeuda Soares Aguiar Neta²
<https://orcid.org/0000-0002-2578-4281>

Luiz Fernando Gouvea-e-Silva³
<https://orcid.org/0000-0002-1953-9175>

Silvia Caroline de Sousa Aguiar⁴
<https://orcid.org/0000-0002-3425-3079>

5

Abstract

Introduction: Autism spectrum disorder (ASD) is an early onset neurodevelopmental disorder characterized by deficits in communication and social interaction, restricted and repetitive patterns of behavior, interests, and activities. **Objective:** To evaluate motor performance characteristics in children with ASD relating this to the sorting obtained by CARS-BR, in reference institutions in the city of Santarém, Pará. **Method:** The study was conducted with 14 children aged 5-12 years, with a clinical diagnosis of ASD. The Childhood Autism Rating Scale (CARS-BR) and the Body Coordination Test for Children (KTK) were used in the study. Data were organized and submitted to descriptive and inferential statistics. **Results:** There was a predominance of males in the sample (85.71%) and the age group of 5-10 years (85.71%). According to the CARS-BR, 50% of children were characterized without autism and 50% with mild/moderate to severe autism. When comparing the mean values of the CARS-BR between genders, it was noted that girls obtained higher scores than boys ($p < 0.0001$). Disturbed/insufficient coordination was present in 71.43% of children. Children >10 years of age were, in relation to those of 5-10 years, worse in the motor quotients of the monopodal and lateral jump, and better in dynamic balance and lateral transposition ($p < 0.05$). Boys were better than girls in monopodal jump, lateral, lateral transposition and final score ($p < 0.05$). **Conclusion:** CARS-BR was not sensitive to classify children with ASD in the study and it is noteworthy that most children showed changes in coordination.

Keywords: Autism spectrum disorder; motor skills disorders; child

¹ Universidade do Estado do Pará, Campus Santarém. Santarém - PA.. E-mail: silvaniayukiko@hotmail.com

² Universidade do Estado do Pará, Campus Santarém. Santarém - PA.. E-mail: zizeldaaguiar@hotmail.com

³ Universidade Federal de Goiás, Regional Jataí. Jataí - GO. Brasil. E-mail: lfgouvea@yahoo.com.br

⁴ Universidade do Estado do Pará, Campus Santarém. Santarém - PA.. E-mail: silviacarolineaguiar@outlook.com

Resumo

Introdução: O transtorno do espectro autista (TEA) é um distúrbio do neurodesenvolvimento que tem início precoce e se caracteriza por déficits na comunicação e interação social e por padrões restritos e repetitivos de comportamento, interesses e atividades. **Objetivo:** Avaliar características do desempenho motor nas crianças com TEA e sua relação com a triagem obtida pela CARS-BR, em instituições de referência na cidade de Santarém, Pará. **Método:** O estudo foi realizado com 14 crianças de 5 a 12 anos, com diagnóstico clínico de TEA. Utilizou-se no estudo a Escala de Classificação de Autismo na Infância (CARS-BR) e o Teste de Coordenação Corporal para Crianças (KTK). Os dados foram submetidos a estatística descritiva e inferencial. **Resultados:** Houve predominância dos meninos (85,71%) e da faixa etária de 5-10 anos (85,71%). De acordo com o CARS-BR, 50% das crianças foram caracterizadas sem autismo e 50% com autismo leve/moderado a severo. Comparando os valores médios da CARS-BR entre os sexos, notou-se que as meninas obtiveram maiores pontuações que os meninos ($p < 0,0001$). A coordenação perturbada/insuficiente estava presente em 71,43% das crianças. As crianças > 10 anos foram, em relação às de 5-10 anos, piores nos quocientes motores do salto monopodal e lateral, e melhores no equilíbrio dinâmico e na transposição lateral ($p < 0,05$). Já os meninos foram melhores que as meninas no salto monopodal, lateral, transposição lateral e escore final ($p < 0,05$). **Conclusão:** A CARS-BR não foi muito sensível para classificar as crianças com TEA do estudo e se destaca que a maioria das crianças apresentou alterações da coordenação.

Palavras-chave: Transtorno do espectro autista; transtorno das habilidades motoras; criança

Introduction

Autistic spectrum disorder (ASD) belongs to the category of neurological development disorders. The disorder starts early and is characterized by deficits in two central domains, communication and social interaction, and by restricted and repetitive patterns of behavior, interests, and activities¹.

According to the World Health Organization, epidemiological studies carried out over the past 50 years demonstrate that the prevalence of ASD appears to be increasing globally. It is estimated that, worldwide, one in 160 children has ASD². The United States has the largest number of children with this diagnosis, followed by Brazil³. Studies have shown that male individuals are four times more likely to develop ASD compared to females⁴.

The etiology of ASD is still not well defined, and there is a tendency not to consider only genetic or environmental determination as definitive. A combination of genetic and non-genetic risk factors has been investigated. Studies have pointed to

higher incidences when there are complications in childbirth and with advanced paternal and maternal age. Genetic studies have suggested that autism is not a genetic condition linked to a single gene, but is the result of simultaneous genetic variations and multiple genes, associated with environmental factors⁵.

Although some evidence suggests that brain abnormalities may begin in the prenatal or neonatal life period, the diagnosis, which is eminently clinical, occurs at around 3 years of age⁶. This could be justified by the variability of occurrences, such as the onset of symptoms becoming apparent in the first year of life or normal development occurring until 12-18 months, and then regression of language and/or social skills, or else a stop in development after 6 months or a slowdown in development with loss of communication skills⁷.

ASD is a permanent condition that can be manifested in different ways in the same individual over the years, due to the typical variability in expression of symptoms and behavioral characteristics of

the syndrome⁸. This range of characteristics and possible combinations leads to some individuals demonstrating severe intellectual disability and low performance in adaptive behavioral skills, while other individuals present a normal intelligence quotient, and lead independent lives⁹.

Studies have evaluated motor development, because of some indications of motor impairment in children with ASD, with motor difficulties being reported retrospectively in children diagnosed late with ASD and observed directly in older children⁶. Some research has evidenced a parallel between motor aptitude, what the child is able to do, and cognition, what the child is able to learn, with studies with motor intervention in children with or without special needs, with motor delays¹⁰, and with ASD¹¹, demonstrating motor gains and positive changes in characteristics, such as social interaction and autonomy.

However, studies on motor aspects for this population are still very scarce, the majority of the research focuses on social communication, neurological processing, and the social inclusion of children and adolescents with ASD, with a gap in the literature regarding the characterization of these aspects and the most appropriate ways to evaluate motor skills¹². The monitoring of motor skills of school-age children is a preventive attitude towards learning, since motor skills are basic components of reading and writing, as well as simple everyday tasks¹¹.

Thus, the present study aimed to evaluate characteristics of motor performance in children with ASD and the relation with the classification obtained using the CARS-BR, in reference institutions in the city of Santarém, Pará.

Methodology

This is a descriptive, cross-sectional study, with quantitative analysis of the data, carried out between May and

September 2019, in two reference institutions in the monitoring of people with disabilities, intellectual or multiple, mostly children and adolescents, in the municipal of Santarém and the neighboring municipalities.

The sample consisted of patients who met the inclusion and exclusion criteria of the research, whose parents or legal guardians signed the Free and Informed Consent Form. In total, 14 children clinically diagnosed with Autism Spectrum Disorder (ASD) participated, between 5 and 12 years of age, of both sexes, who received multiprofessional care in these centers.

The information was collected through a clinical data sheet, produced by the authors. Subsequently, the *Childhood Autism Rating Scale* (CARS-BR) and the *Körperkoodination Test Fürkinder* (KTK) test were applied. The tools were applied in spaces provided by the institutions. Parents and/or guardians were present at all stages, together with the examiners.

The CARS is a brief and appropriate screening tool for use in children over 2 years of age. In the current study, the version translated and validated for Portuguese by Pereira, Riesgo and Wagner (2008) was used¹³. The CARS-BR was applied in an interview format, where the child and a family member were present to answer the evaluator's questions. In the current study, the scale was used to classify children as to the degree of severity of ASD and not as an instrument to assist in clinical diagnosis.

The CARS evaluate behavior in 14 domains commonly affected in autism, plus a general category of autism impression, divided into: personal relationships, imitation, emotional response, body use, use of objects, response to changes, visual response, auditory response, response and use of taste, smell, and touch, fear or nervousness, verbal communication, non-verbal communication, activity level, level and consistency of intellectual response,

and general impressions. Scores between 36 and 60 indicate severe autism, 30-35 indicate moderate autism, and less than 30 indicate no autism.

The KTK test, produced by the German researchers Kiphard and Scchilling in 1974, assesses the motor performance in which some elements of motor coordination are involved, such as balance, rhythm, strength, laterality, speed, and agility. The test was designed to determine the state of development of the body domain of children between 5 to 14 years and 11 months. The test consists of four different tasks, and in the first task, balance beam, dynamic balance is mainly verified; in the second, monopodal jumps, the strength of the lower limbs; in the third, lateral jumps, speed; and in the fourth, laterality and, transfer on platforms, spatio-temporal structuring¹⁴.

For the analysis of the KTK, the result of each task (gross values) is transformed into motor quotients (MQ), and the reference tables for each task are checked according to the sex and age of the participants (MQ1, MQ2, MQ3, and MQ4). Subsequently, the sum is performed and the total MQ is obtained. This motor quotient refers to a score, which, in turn, allows the classification of motor coordination into five levels: very good global motor coordination; good global motor coordination; normal global motor coordination; disturbed global motor coordination; and insufficient global motor coordination¹⁴.

For analysis of the results obtained, the age range of the patients was stratified according to motor development, into: from 5 to 10 years and above 10 years¹⁵.

The data were organized and tabulated for the analysis of descriptive statistics (mean, standard deviation, absolute and relative frequency). For inferences, the unpaired T test was used for comparisons, considering the parametric

pattern of the data (Shapiro-Wilk test) and Fisher's exact test for associations. The program used was BioEstat 5.3, with a significance level of $p < 0.05$.

This work is part of a Scientific Initiation Project and was approved by the Ethics Committee of the State University of Pará, campus XII, under CAAE: 89789018.0.0000.5168.

Results

Initially 25 children diagnosed with Autistic Spectrum Disorder participated in the study. After applying the exclusion criterion, participation in all stages of the study, the sample included a total of 14 children, aged between 5 and 12 years (mean of 7 ± 2.53 years), being 85.71% ($n=12$) aged 5 to 10 years and 85.71% ($n=12$) male.

According to the results found from the application of the CARS-BR, 50% ($n=7$) of the participants scored below 30 points, without a classification of autism, 28.57% ($n=4$) were classified as having mild to moderate autism, and 21.43% ($n=3$) as having severe autism. The girls presented higher mean scores in the domains of verbal communication (3.75 ± 0.35), activity level and intellectual response (3.25 ± 1.06), and overall impression (3.75 ± 0.35). The highest means for the boys were in the domains of verbal communication (2.38 ± 0.74), activity level (2.38 ± 0.74), and global impression (2.54 ± 0.43). When comparing the means of the CARS-BR between sexes, it was noted that girls obtained a higher score than boys (40.75 ± 1.77 vs 28.38 ± 4.99 ; $p < 0.0001$).

Regarding the results found in the application of the KTK tests, alterations in coordination were observed in 71.43% of the participants ($n = 10$) (Table 1).

Table 1: Distribution of the KTK test results.

KTK Classification	n	%
Very good coordination	0	0
Good coordination	0	0
Normal coordination	4	28.57
Disturbed coordination	7	50
Insufficient coordination	3	21.43

Source: Authors of the study

When associating the KTK test result with sex and age group, no statistical association was observed (Table 2).

Table 2: Association of the KTK test with the participants' sex and age group.

		NC	DP/IC	p*
		n/%	n/%	
Sex	Female (n=2)	0/0	2/20	0.5604
	Male (n=12)	4/100	8/80	
Age group	5 – 10 years (n=12)	3/75	9/90	1.0
	Over 10 years (n=2)	1/25	1/10	

Legend: NC - Normal coordination; DC – Disturbed coordination; IC - Insufficient coordination; * Fisher's exact test

Source: Authors of the study

Table 3 presents the comparisons by age and sex of the motor quotients obtained by the KTK test. It is noteworthy that there was no statistical difference for

the final score in relation to the age group ($p>0.05$) and the MQ1 for sex ($p>0.05$).

Table 3: Comparisons of the KTK test motor quotients by age and sex.

Variables	MQ1 (Mn/SD)	MQ2 (Mn/SD)	MQ3 (Mn/SD)	MQ4 (Mn/SD)	Final score (Mn/SD)
Age group					
5 - 10 years	66.2 ± 10.2*	68.0 ± 13.6*	58.8 ± 15.1*	48.8 ± 7.4*	78.5 ± 9.7
> 10 years	87.5 ± 12	59.7 ± 49	49 ± 18.4	60 ± 21.3	82 ± 17
Sex					
Female	70.5 ± 36.1	37.5 ± 7.8#	32 ± 5.7#	38 ± 9.9#	62 ± 11.3#
Male	69 ± 8.4	71.7 ± 12	61.7 ± 11.6	52 ± 8.6	82 ± 7.0

Legend: MQ1 - Dynamic Balance; MQ2 - Monopodal jump; MQ3 - Lateral Jump; MQ4 - Lateral Transposition; Md - mean; SD - standard deviation; * Statistical difference from the age group over 10 years; # Statistical difference from the female sex; $p<0.05$.

Source: Authors of the study

When the association was verified between the presence or absence of autism and mild/moderate or severe autism, according to the CARS-BR classification,

with normal or disturbed/insufficient coordination, no significance was noted (Table 4; $p>0.05$).

Table 4: Association of the coordination test with the classification carried out by the CARS-BR.

Variables	CN n/%	PC/IC n/%	p*
1st analysis			
Not Autistic (n=7)	3/75	4/40	0.5594

Autistic (n=7)	1/25	6/60	
2nd analysis			
Mild/moderate autism (n=4)	1/100	3/50	1.0
Severe autism (n=3)	0	3/50	

Legend: NC - Normal coordination; DC – Disturbed coordination; IC - Insufficient coordination; * Fisher's exact test

Source: Authors of the study

Of the total participants, 71.43% (n=10) of participants with ASD use continuous medications. Risperidone, an antipsychotic, was the most prescribed medication (64.29%; n=9), followed by the use of the anticonvulsant Carbamazepine (14.29%; n=2). Other drugs prescribed were: Lamotrigine; Clobazam; Trileptal; Olanzapine; Tofranil; and Imipramine. Finally, only 35.71% (n=5) of the participants did not use prescription drugs or report continuous use of drugs.

Table 5 demonstrates that there was no statistical association between the use of medication and the presence or absence of autism, according to the CARS-BR classification, and with or without alterations in coordination. However, attention is drawn to the high frequency of medication use for non-autistic patients (67% vs 33%) and the use of medication with disturbed/insufficient coordination (78% vs 22%).

Table 5: Association of drug use with the classification of the CARS-BR and KTK.

Variables	Medication		p*
	Do not use (n=5) n/%	Use (n=9) n/%	
CARS – BR Classification			
Not autistic (n=7)	1/20	6/67	0.2657
Autistic (n=7)	4/80	3/33	
KTK Classification			
Normal coordination (n=4)	2/40	2/22	0.5804
Disturbed/Insufficient coordination (n=10)	3/60	7/78	

Legend: * Fisher's exact test.

Source: Authors of the study

Discussion

From the methodology used in the current study the sample contained predominantly male children. A higher incidence of ASD in this sex (4: 1) was identified in other studies^{4,5}, which increased to 7: 1 for highly functional autists¹⁶. In contrast, the girls had higher scores on the CARS-BR (table 1), encouraging the proposed hypothesis of a female protective model, suggesting that greater genetic mutations are necessary for the clinical manifestations of ASD in women¹⁶, since women with ASD have a greater number of genetic variants associated with the disorder, suggesting

that female individuals are more resistant to these mutations.

When we analyze the results obtained in each domain of the CARS-BR, it can be observed that verbal communication is the most affected item in both sexes, which is consistent with the characteristics described in other studies, where communication, whether verbal or non-verbal, and social interaction deficits are predominantly found in this population¹⁷.

From the results of the CARS-BR, the classification “without autism” was obtained for 50% of children, despite the inclusion criterion being participants with a clinical diagnosis of ASD. A similar result

was obtained by Santos et al. (2016)¹⁸ with 41.66% of the 29 participating children, attended at the Maringaense dos Autistas Association, characterized as without Autism according to the CARS. Other studies that compared tests that assess ASD found similar results, indicating that the CARS is sensitive for identifying autism by its cut-off score, especially in cases with mild-moderate or severe autism, but not for individuals with Asperger's Syndrome and Unspecified Global Development Disorder^{19,20}.

Moulton et al (2019)²¹ report that the scale has some limitations, considering the high heterogeneity of symptoms and the variability in the severity of the basic deficits associated with ASD; exemplifying that a child may have severe deficits in the domain of communication/social interaction, but relatively less serious repetitive behaviors or interests. Alternately, lower evaluations in one domain, such as the presence of stereotyped behavior, might simply not have been observed during the limited evaluation period. Therefore, a single total score may not better represent the severity of a child's ASD and, in turn, may not be the most useful in determining the diagnosis.

Performance in the KTK test showed a prevalence of unsatisfactory results (table 2), with no statistical associations by sex or age group (table 3). When evaluated individually by MQ (table 4), it is clear that girls presented significantly lower mean scores than boys, except for MQ1 (dynamic balance). The difficulty in presenting more accurate statistics can be explained by the small groups.

The result found, when analyzing the KTK tests separately, is similar to that found by Silva Junior (2012)²², where the tests of lateral jumps and lateral transposition presented the lowest performance indices, while on the balance beam the sample obtained the best performance. The greatest impairments in

the sample were in the elements of speed and laterality, while the best performance was achieved in dynamic balance.

Some authors address the occurrence of motor coordination deficit in ASD, which manifests itself mainly as difficulty in performing fine motor coordination movements, using tools, and learning complex motor skills⁷. A child with ASD demonstrates difficulty in understanding their body as a whole and in segments, as well as their body in motion; there is a deficit in body perception, which makes movements, gestures, and actions poorly adapted²³. In the study with 131 girls with autism and/or attention deficit/hyperactivity disorder (ADHD), the predictive factors for coordination problems were younger ages, autistic symptoms, and poor IQ, intelligence quotient, performance²³.

According to Fernandes²⁴, in his review, in ASD the notion of body scheme does not develop properly. The development of static balance, laterality, and the notion of reversibility is impaired, as well as the basic functions necessary for the acquisition of autonomy and cognitive learning. In a motor intervention study with a child with ASD, the area of the child's greatest motor impairment was the body scheme and motor gains were observed in four of the six motor areas assessed in the child, demonstrating the possibility of therapeutic alternatives¹¹.

Based on the performance of the sample in the KTK test, and when relating to the classification obtained in the CARS-BR (table 5), it was found that the more severe the level of autism, the greater the impairment in motor coordination, without significant associations, probably due to sample size. The lack of social interaction and restricted repertoire of activities and interests perceived in children with ASD¹⁷ would justify the decrease in stimuli and could be configured as an important factor for deficits in motor skills.

Regarding the use of medication by the sample, there was no association with

the CARS classification or KTK results. It was observed that the majority of the children who use one or more drugs received a classification of non-autistic on the CARS-BR, which may have contributed to this classification, since it may have masked the findings characteristic of ASD.

There is no standard drug treatment for ASD, although psychopharmacological treatment of children, adolescents, and adults with the disorder is very common in clinical practice, as these drugs contribute to the easing of stereotypies. This approach is designated palliative, as it does not aim to cure the disease, but rather to control symptoms that are more recurrent and harmful to the individual's functionality²⁵.

The KTK test was produced a priori to determine the level of body development of children with disabilities, however, because it evaluates both global motor coordination and allows the identification of children with motor coordination disorders, the test is also currently used in children without disabilities¹⁴. However, in the present study, some adaptations were necessary: the number of attempts to perform the tasks was increased from one to three attempts on the balance beam and in the lateral jump and the time interval between valid attempts was increased from ten seconds to one minute in the lateral jump and in the lateral transposition.

Some aspects influence the application of KTK with these children, such as difficulty in attention and concentration, lack of interest in the proposed activities, difficulty in following commands, difficulty in being observed, as well as the test being somewhat atypical in their routine. The environment, even though it is already part of the routine of some children, had a new purpose. The lack of a bond between the participants and the applicators also made it difficult to interact and affected their willingness to respond to commands. The characteristics typically seen in the ASD, such as

repetitive and restricted patterns of behavior, activities, and interests and adherence to the routine, which when suffering alterations generate discomfort and can cause hyper or hypo-reactivity on the part of the child, could compromise the results. The difficulties encountered lead us to infer that the test may not be the most suitable for the application in this group.

The practice of physical activities is known to be beneficial for children and young people in general, and this is no different for those with ASD. The meta-analysis carried out by Huang et al (2020)²⁶, in 12 randomized clinical trials, shows that physical activities, such as sports games, water sports, soccer, aerobics, karate, horse riding, and other physical activities, can improve the ability of social interaction and communication skills of children and adolescents with autism, improve motor skills, and reduce the degree of autism in children.

Growing evidence links motor impairment to delays in global development in children with ASD. Wilson, Enticott and Rinehart (2018)²⁷ analyze that the assessment of motor function in ASD, through quantitative and neurodiagnostic measures, is delayed in relation to other behavioral phenotyping. The identification of motor deficiencies in ASD, and the underlying neural mechanisms that may be involved, enables the development of targeted interventions, as well as providing the expansion of studies that evaluate the importance of motor function for other domains of development in ASD.

Conclusion

The sample in this study was prevalent in male children, with females showing greater impairment in the classification of ASD. There was a prevalence of altered motor patterns in the sample, with alterations in coordination.

The CARS was sensitive to identify autism in cases with mild-moderate or

severe autism, however it was not efficient to diagnose most of the sample, despite the clinical diagnosis, probably in the case of children with mild impairment. It is important to clarify that the use of the CARS in this study aimed to demonstrate the degree of severity of autists and was not intended as an instrument to assist in clinical diagnosis.

The motor difficulties identified in ASD are important findings, which could contribute to early detection of their occurrence, in addition to the most prevalent findings. The application of the

KTK test required some adaptations, raising the question of its applicability in this group.

In addition to targeted motor interventions, there is a need to provide sensorimotor experiences to children with ASD through physical activities and sports, enabling an increase in their relationship with the world and an increase in therapeutic possibilities.

Referências

1. American Psychiatric Association. *Developmental Coordination Disorder. Diagnostic and statistical manual of mental disorder (DSM-5)*. 5th ed. Arlington; 2013.
2. Organização Pan-Americana da Saúde (OPAS). *Folha informativa - Transtorno do Espectro Autista*. Abril, 2017. Disponível em <https://www.paho.org/bra/index.php?Itemid=1098>.
3. Cavaco N. *Minha criança é diferente? Diagnóstico, prevenção e estratégia de intervenção e inclusão das crianças autistas e com necessidades educacionais especiais*. Rio de Janeiro: Wak Editora, 2014.
4. Ribeiro AS, David AC, Barbacena MM, Rodrigues M, França NM. *Teste de Coordenação Corporal para Crianças (KTK): aplicações e estudos normativos*. *Motricidade* 2012; 8 (3):40-51.
5. Shimitd C. *Transtorno do Espectro Autista: Onde estamos e para onde vamos*. *Psicologia em Estudo* 2017; 22 (2):221-230.
6. Landa R, Garrett-Mayer E. *Development in infants with autism spectrum disorders: a prospective*. *Journal of Child Psychology and Psychiatry*. 2006; 47 (6):629-638.
7. Almeida SSA, Mazete BPGS, Brito AR, Vasconcelos MM. *Transtorno do Espectro Autista*. *Resid Pediatr*. 2018 8(0 Supl.1):72-78.
8. Sella, AC, Ribeiro EM. *Análise do Comportamento Aplicada ao Transtorno do Espectro Autista*. Appris Editora e Livraria Eireli - ME, 2018.
9. Griesi-Oliveira K, Sertié AL. *Transtornos do espectro autista: um guia atualizado para aconselhamento genético*. *Einstein (São Paulo)* 2017; 15(2):233-238.
10. Guaragna MM, Pick RK, Valentini NC. *Percepção de pais e professores da influência de um programa motor inclusivo no comportamento social de crianças portadoras e não-portadoras de necessidades especiais*. *Movimento* 2005; 11:89-117.
11. Rosa Neto F, Amaro KN, Santos APM, Xavier RFC, Echevarrieta JC, Medeiros DL, Gomes LJ. *Efeitos da intervenção motora em uma criança com transtorno do espectro do autismo*. *Temas sobre Desenvolvimento* 2013; 19(105):110-4.
12. Catelli CLRQ, D'Antino MEF, Blascovi-Assis SM. *Aspectos motores em indivíduos com transtorno do espectro autista: revisão de literatura*. *Cad. Pós-Grad. Distúrb. Desenvol.* [online]. 2016; 16 (1):56-65.
13. Pereira A, Riesgo RS, Wagner MB. *Childhood autism: translation and validation of the Childhood Autism Rating Scale for use in Brazil*. *J. Pediatr. (Rio J.)* [online]. 2008; 84(6):487-494 de *Pediatria*, 2008.

14. Gorla JI, Araújo PF, Rodrigues JL, Pereira VR. O teste KTK em estudos da coordenação motora. *Conexões (Campinas)* 2015; 1(1):29-38.
15. Ré AHN. Crescimento, maturação e desenvolvimento na infância e adolescência: implicações para o esporte. *Motricidade* 2011; 7(3):55-67.
16. Jacquemont S, Coe BP, Hersch M, Duyzend MH, Krumm N, Bergmann S, Beckmann JS, Rosenfeld JA, Eichler EE. A Higher Mutational Burden in Females Supports a "Female Protective Model" in Neurodevelopmental Disorders. *Am J Hum Genet.* 2014; 94(3):415-425.
17. Klin, A. Autismo e síndrome de Asperger: uma visão geral. *Rev. Bras. Psiquiatr.* [online]. 2006; 28(supl.1):S3-S11.
18. Santos ER, Colla L, Kempinski EC, Bueno FC, Mendes FCV. Autismo: caracterização e classificação do grau de severidade dos alunos da Associação Maringense dos Autistas (AMA) com base no método CARS. *Braz. J. Surg. Clin. Res.* 2016; 15(3):37-41.
19. Rellini E, Tortolani D, Trillo S, Carbone S, Montecchi F. Childhood Autism Rating Scale (CARS) and Autism Behavior Checklist (ABC) correspondence and conflicts with DSM-IV criteria in diagnosis of autism. *J Autism Develop Dis.* 2004; 34(6):703-8.
20. Santos THF, Barbosa MRP, Pimentel AGL, Lacerda CA, Balestro JI, Amato CAH, Fernandes FDM. Comparação dos instrumentos Childhood Autism Rating Scale e Autism Behavior Checklist na identificação e caracterização de indivíduos com distúrbios do espectro autístico. *J Soc Bras Fonoaudiol.* 2012; 24(1):104-6.
21. Moulton E, Bradbury K, Barton M, Fein D. Factor Analysis of the Childhood Autism Rating Scale in a Sample of Two Year Olds with an Autism Spectrum Disorder. *J Autism Dev Disord* 2019; 49:2733–2746.
22. Silva Júnior LP. Avaliação do perfil motor de crianças autistas de 7 a 14 anos frequentadoras da Clínica Somar da cidade de Recife-PE. Trabalho de conclusão de curso (Graduação em Licenciatura Plena em Educação Física) - Universidade Estadual da Paraíba, Campina Grande, 2012. Disponível em: <http://dspace.bc.uepb.edu.br/jspui/handle/123456789/761>.
23. Kopp S, Beckung E, Gillberg C. Developmental coordination disorder and other motor control problems in girls with autism spectrum disorder and/or attention-deficit/hyperactivity disorder. *Res Dev Disabil.* 2010 Mar-Apr;31(2):350-61.
24. Fernandes FS. O Corpo no Autismo. *PSIC-Revista de Psicologia da Vetor Editora* 2008; 9(1):109-114.
25. Nikolov R, Jonker J, Scahill L. Autismo: Tratamentos Psicofarmacológicos e áreas de interesse para desenvolvimentos futuros. *Rev. Bras. Psiquiatr.* [online]. 2006; 28(supl. 1):S39 – S46.
26. Huang J, Du C, Liu J, Tan G. Meta-Analysis on Intervention Effects of Physical Activities on Children and Adolescents with Autism. *Int. J. Environ. Res. Public Health* 2020; 17(6):1-11.
27. Wilson RB, Enticott PG, Rinehart NJ. Motor development and delay: advances in assessment of motor skills in autism spectrum disorders. *Curr Opin Neurol.* 2018; 31(Issue 2):134-139.

Como citar este artigo:

Takanashi SYL, Aguiar Neta ZS, Gouvea-e-Silva LF, Aguiar SCS Evaluation of motor aspects performance in children with autistic spectrum disorder in Amazon reference institutions. *Rev. Aten. Saúde.* 2020; 18(64): 162-171.