

Content validity of an instrument for motor assessment of youth with autism

Validação de conteúdo de instrumento para a avaliação motora de jovens com autismo

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Abstract

Introduction: Children and adolescents with autism spectrum disorder (ASD) present motor disorders that have been the focus of physical therapy interventions. However, the standardized motor assessments available in the literature have important gaps, among them the complexity of the tasks evaluated and the absence of qualitative information about the subjects' performance.

Objective: To develop and evaluate the content validity of the Gross Motor Assessment of Children and Adolescents with ASD checklist (GMA-AUT checklist). **Methods:** The GMA-AUT checklist was sent to a committee of experts for content validation. The content validity index (CVI) was used to assess the degree of agreement between the experts. To verify the content validity of the checklist, the minimal acceptable CVI was 0.80. **Results:** Based on the suggestions made, the GMA-AUT was reformulated and submitted to the same panel of experts for reassessment. In the second and final draft of the checklist, only two items had a CVI of 0.88, while all others reached a CVI of 1.00. **Conclusion:** The GMA-AUT checklist presents adequate content validity for assessing gross motor in children and adolescents with ASD according to experts in the field.

Keywords: Autism spectrum disorder. Physical therapy. Validity.

Resumo

Introdução: Crianças e adolescentes com transtorno do espectro autista (TEA) apresentam alterações motoras que têm sido foco de intervenções fisioterapêuticas. Contudo as avaliações motoras padronizadas disponíveis na literatura possuem lacunas importantes, entre elas a complexidade das tarefas avaliadas e a ausência de informação qualitativa sobre o desempenho dos sujeitos. **Objetivo:** Desenvolver e avaliar a validade de conteúdo do instrumento “Avaliação Motora Grossa de Crianças e Adolescentes com Transtorno do Espectro Autista” (GMA-AUT). **Métodos:** A versão inicial do instrumento GMA-AUT foi enviada a um comitê de especialistas no tema para a validação de conteúdo através de um questionário. Para avaliar o grau de concordância entre os especialistas, utilizou-se o índice de validade de conteúdo (IVC), sendo IVC de 0,80 o mínimo aceitável. **Resultados:** A partir das sugestões dos especialistas na primeira rodada de avaliação, o GMA-AUT foi reformulado e a partir da segunda, originou-se a versão final. Na versão final do instrumento apenas dois itens apresentaram IVC de 0.88, enquanto todos os demais apresentaram IVC de 1.00. **Conclusão:** O instrumento GMA-AUT apresenta validade de conteúdo adequada para a avaliação motora grossa em crianças e adolescentes com TEA segundo especialistas na área.

Palavras-chave: Transtorno do espectro autista. Fisioterapia. Validação.

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder of heterogeneous presentation, which is characterized by difficulty in communication and social interaction and the presence of repetitive or restricted behaviors and/or interests.¹ Even in the first reports on autism, a variety of movement abnormalities were described, including atypicalities in postural control, gait, movements of the upper limbs and fine motor coordination. However, these signs have not been investigated over the years as deeply as social deficits.² Furthermore, recently, motor problems have been related to the central symptoms of ASD, being one of the limiting causes of social interactions.^{3,4}

The underdevelopment of motor skills induces a vicious cycle, in which movement avoidance leads to reduced physical interaction and consequently an increased discrepancy in motor skills, when compared to

typical children.⁵ By promoting experimentation with a variety of movements, motor interventions can increase body awareness and help in the creation of social bonds between individuals.⁶ Physiotherapeutic work with the autistic public is still a recent practice⁷ and little described in the literature. However, there is evidence that physical therapeutic interventions not only improve motor skills but also improve social aspects in children with ASD, reducing aggression and repetitive behaviors.⁸

A recent systematic review showed that the available standardized motor assessments used to assess motor skills in children with ASD are effective for differentiate them from typical children, but do not provide accurate information about motor development in ASD. Furthermore, the authors reported assessments limitations, such as the absence of the autistic public in the study samples and insufficient detailing of the motor patterns performed, merely considering whether the child is able to complete the requested movement.⁹

In this context, the use of quantitative tools that provide qualitative information on the nature of motor patterns in the assessment of children and adolescents with ASD is considered essential. Many methods such as 3D analysis and plantar pressure analysis systems have been employed;⁹ however, due to their high cost, they end up restricted to the research context, and the gap in the outpatient evaluation of these children and young people remains. On the other hand, an instrument such as a checklist can be used both in research and in clinical practice, due to its low cost and ease of accessibility.

Given this scenario, the objective of this study was to develop and assess the content validity of the Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder (GMA-AUT checklist). Since it has been developed specifically for the clinical practice of physical therapists of this field, our hypothesis is that the GMA-AUT checklist will be able to provide valid information about the motor patterns of children and adolescents with autism spectrum disorder.

Methods

This study consists of an applied research on the development and content validity of the GMA-AUT checklist. It was approved by the Ethics and Research Committee of the Universidade Federal do Rio Grande do Sul, Brazil (CAAE 32720020.2.0000.5334) where it was carried out.

The development of the GMA-AUT checklist followed the standards on content validity of the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN),¹⁰ which consists in a checklist that can be used by researchers who are conducting studies to assess measurement properties.

Development of the checklist

The GMA-AUT checklist consists of an observational assessment of gross motor skills of children and adolescents with ASD from four to 18 years of age and was designed to minimize the interference from the evaluator as much as possible. The assessment setting must be previously prepared and equipped, based on the instructions from the checklist (Appendix 1).

The first draft of the GMA-AUT checklist was developed in three phases: (1) exploratory phase, which has provided information for the initial composition of the checklist, based both on informal conversations with physical therapists and the practical experience of the researchers; (2) literature review, which has confirmed the initial information from the previous phase; (3) literature review to identify instruments used for gross motor assessment of children and adolescents with ASD, as well as their strengths and weaknesses. Each GMA-AUT item assesses the execution of postural changes and maintenance, gait, balance and object exploration. Each item is divided in two sections (Figure 1).

The first section corresponds to the individual's ability to perform the activity ("performs" or "does not perform"). It contains a decreasing score that varies from 5 to 0 points and considers the need and graduation of prompts. Prompts are the stimuli done by the evaluator to help the individual to perform a desired behavior.¹¹ If the subject does not need the prompt to perform the activity ("no prompt"), a score of 5 points should be assigned. The verbal prompt is a command said by the evaluator (4 points). The gestural prompt is a gesture the evaluator does, for example, using the hands, tilting the head or looking at some direction, without touching the subject (3 points). The "modeling" consists in the evaluator performing the evaluated activity, giving a model of the action the subject should imitate (2 points). The "partial physical prompt" occurs when evaluator touches the individual to give sensory input on the direction of the movement that should be performed, promoting the beginning of the action for the individual, who completes the movement by oneself (1 point).¹¹ The assessment should be carried out using the less-to-more

prompt hierarchy, in order to assess the individual's ability to perform the demand with the least intrusive prompt possible.¹² If the individual does not perform the activity, even with the maximum acceptable prompt (partial physical prompt), the respective check box in the column "does not perform" should be marked, that is, if the activity was not performed due to motor inability or due to "non-motor" reasons, which include inappropriate behaviors, such as tantrums and escapes. Both answers score 0 point in the assessment.

The second section of the items ("how he/she performs the activity") approaches the motor performance of the individual, when the evaluator should observe how the subject performs the action to rate it according to the answer options. The number of answer options in this section varies from item to item, being the highest score correspondent to the one found in typical development.

The sum of the scores of each section ("performs or does not perform" + "how") represents the item's score. To obtain the final GMA-AUT score, the scores of all items must be summed and then divided by the maximum score of the checklist. The final score of the individual is in percentage (Figure 2). The first draft of the checklist had 18 items, which are listed in Table 1.

Table 1 - Items in the first draft of the GMA-AUT checklist

Item	Name of the item
1	Seated on the floor to standing
2	Seated on a bench to standing
3	Standing to seated on the floor
4	Seated on the floor
5	Standing to seated on a bench
6	Standing on solid/stable surface
7	Standing on soft/semi-unstable surface
8	Standing, eyes closed
9	Standing, kicking a ball with the right foot
10	Standing, kicking a ball with the left foot
11	Standing, catching a ball thrown towards him/her
12	Walking for five meters
13	Transposing of obstacles
14	Going up stairs
15	Going downstairs
16	Going up a ramp with a minimal inclination of 45°
17	Going down a ramp with a minimal inclination of 45°
18	Motor stims

Note: GMA-AUT = Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder.

PERFORM					DOES NOT PERFORM		SCORE
☐ (5) No prompt	☐ (4) Verbal prompt	☐ (3) Gestural prompt	☐ (2) Modeling	☐ (1) Partial physical prompt	☐ (0) Motor	☐ (0) Non-motor	
HOW							SCORE
☐ (4) With free arms, he/she changes to kneeling, half-kneeling and stands up.	☐ (3) Supporting his/her weight on the arms against the body, he/she changes to kneeling, half-kneeling and stands up.	☐ (2) Supporting his/her weight on the arms against the floor, he/she moves into bear standing and then standing up.	☐ (1) With the arms against furniture, he/she pulls him/herself for standing up.				

Figure 1 - Example of answer options for item 1 in the Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder (GMA-AUT) checklist (seated on the floor to standing): sections *perform/does not perform* and *how* (he/she performs the activity), and their respective fields for scoring.

ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	SUM	TOTAL
Item score																		___/190=___%	

Figure 2 - Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder (GMA-AUT) checklist scoring table in the first draft of the GMA-AUT checklist.

Expert review

The group of experts included nine neuropsychiatric physiotherapists with experience in caring for children and adolescents with ASD, which were selected by convenience. According to Lynn,¹³ the definition of the number of experts is somehow arbitrary when determining the content validity of an instrument. However, the author suggests that a minimum of five experts would provide a sufficient level of control for chance agreement, with a minimum number of three experts being acceptable if the content area is very restricted. Other researchers in the field of instrument development agree with the number of experts proposed by Lynn¹³ and suggest five to ten professionals,^{14,15} considering that a larger number of experts can provide more information about an instrument.¹⁶

The initial search for experts was performed in scientific articles of the area and in posts on social networks. Professionals working in public rehabilitation institutions, private physical therapy clinics and physical therapy school clinics were selected.

After the initial contact with the experts, we sent the informed consent form (ICF) for those who accepted the invitation so that they could manifest their assent to participate in the research.

Data collection

After assenting to participate in the research, the experts received two files by e-mail: (1) the first draft of the GMA-AUT checklist and (2) a specific questionnaire for content validation.

The content validation questionnaire, which was designed specifically for this research, aimed to evaluate two variables: (a) clarity (checking the instrument format and the wording of title and instructions); and (b) validity (checking the 18 items of the checklist).

Clarity in instrument format and in the wording of title and instructions were evaluated using a 4-point Likert scale as follows: not clear (1 point); less clear (2 points); clear (3 points); and very clear (4 points). Each of the 18 items of GMA-AUT checklist was scored for content validity as invalid (1 point); less valid, need for a major revision (2 points); valid, need for a minor revision (3 points); and completely valid (4 points).¹⁴ The experts were asked to justify their answers in all the items of the content validation questionnaire they rated as 1, 2 or 3 points and to state what they have considered inappropriate. Still, in the end of the questionnaire there was a 15-line space for the experts spontaneously evaluate the instrument, providing critics and/or observations.

From the first draft of the instrument, the content validation was developed in three phases: (1) content assessment of the GMA-AUT checklist's first draft, which was appraised by experts in the field of neuropsychiatric physical therapy, who are experienced in caring for children and adolescents with ASD; (2) development of GMA-AUT checklist's second draft, which was carried out by two researchers who considered the experts' suggestions; and (3) presentation of the revised checklist (second draft) to the experts for content reassessment, from which the final draft of the checklist was obtained.

The content validity index (CVI) was used to determine experts' agreement on GMA-AUT checklist's content validation, measuring the content validity of each item and the checklist as a whole. For this, the following indexes were used: (1) Item-level content validity index (I-CVI), which is the proportion of experts giving item a rating of 3 or 4; (2) Scale-level content validity index/universal agreement calculation method (S-CVI/UA), which is the proportion of items rated as of 3 or 4 by all the experts; (3) Scale-level content validity index/averaging calculation method (S-CVI/Ave), which is the average for all items' responses, obtained by summing

the I-CVI and dividing it by the number of questions in the content validity questionnaire; (4) proportion of relevance given by each expert (PRE), which is the proportion of questions each expert rated as 3 or 4; and (5) mean expert proportion (MEP), which is the mean PRE.¹⁵ The acceptable agreement rate among experts to verify the validity of a new instrument, in general, must be at least 0.80 and, preferably, higher than 0.90.^{15,17}

Results

During the process of content validity, the GMA-AUT instrument underwent two rounds of evaluation with the experts. After round 1, one expert withdrew consent to participate in the study, so the answers from this person were unconsidered in all rounds of assessment of the instrument. Then, eight experts participated in the whole process of content validity.

In round 1, the I-CVI ranged from 0.50 to 1.00 (Table 2), the S-CVI/Ave was 0.92, the S-CVI/UA was 72%, the PRE ranged from 83% to 100%, and the MEP was 91% (Table 2).

Table 2 - Results for round 1 of the Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder (GMA-AUT) checklist's Assessment

ITEM	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Agreement	I-CVI
1	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
2	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
3	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
4	✓	✓	x	✓	✓	✓	✓	✓	7	0.88
5	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
6	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
7	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
8	✓	x	✓	x	x	✓	✓	x	4	0.50
9	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
10	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
11	✓	✓	✓	x	✓	✓	✓	✓	7	0.88
12	✓	✓	✓	✓	x	✓	✓	x	6	0.75
13	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
14	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
15	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
16	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
17	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
18	✓	✓	x	x	x	✓	✓	x	4	0.50
PRE (%)	100	94	89	83	83	100	100	83	S-CVI/Ave = 0.92	
	Mean PRE= 91%								S-CVI/UA = 72%	

Note: ✓ = Item rated as 3 or 4 in the questionnaire of content validation of GMA-AUT checklist; x = item rated as invalid or less valid by the experts. Item 1 = seated on the floor to standing; Item 2 = seated on a bench to standing; Item 3 = standing to seated on the floor; Item 4 = seated on the floor; Item 5 = standing to seated on a bench; Item 6 = standing on solid/stable surface; Item 7 = standing on soft/semi-unstable surface; Item 8 = standing, eyes closed; Item 9 = standing, kicking a ball with the right foot; Item 10 = standing, kicking a ball with the left foot; Item 11 = standing, catching a ball thrown towards him/her; Item 12 = walking for five meters; Item 13 = transposing of obstacles; Item 14 = going up stairs; Item 15 = going downstairs; Item 16 = going up a ramp with a minimal inclination of 45°; Item 17 = going down a ramp with a minimal inclination of 45°; Item 18 = motor stims; I-CVI = Item-level content validity index; S-CVI/UA = Scale-level content validity index/universal agreement calculation method; S-CVI/Ave = scale-level content validity index/averaging calculation method; PRE = proportion of relevance of each expert.

Items with I-CVI of 0.50 were excluded from the second draft of the instrument and the remaining items were reformulated following the suggestions provided by the experts. One of the suggestions was the inclusion of a new item called "vertical jump". Also, the experts suggested altering the order of the items and dividing them into "static assessment", when the items refer to the maintenance of a posture, and "dynamic assessment",

when the items refer to postural change, walking or controlling an object. In round 2, only two items presented I-CVI of 0.88 while all other items presented I-CVI of 1.00. The S-CVI/Ave was 0.99, the S-CVI/UA was 88%, the PRE ranged from 88% to 100%, and the MEP was 98% (Table 3). The results obtained in this round justified the ending of the process of content validity and the creation of the final draft of GMA-AUT checklist.

Table 3 - Results for round 2 of the Gross Motor Assessment of Children and Adolescents with Autism Spectrum Disorder (GMA-AUT) checklist's Assessment

ITEM	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Agreement	I-CVI
1	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
2	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
3	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
4	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
5	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
6	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
7	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
8	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
9	✓	✓	x	✓	✓	✓	✓	✓	7	0.88
10	✓	✓	x	✓	✓	✓	✓	✓	7	0.88
11	✓	✓	✓	x	✓	✓	✓	✓	8	1.00
12	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
13	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
14	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
15	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
16	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
17	✓	✓	✓	✓	✓	✓	✓	✓	8	1.00
PRE (%)	100	100	88	100	100	100	100	100	S-CVI/Ave = 0.99	
	Mean PRE = 98%								S-CVI/UA = 88%	

Note: ✓ = Item rated as 3 or 4 in the questionnaire of content validation of GMA-AUT checklist; x = item rated as invalid or less valid by the experts. Item 1 = seated on the floor to standing; Item 2 = seated on a bench to standing; Item 3 = standing to seated on the floor; Item 4 = seated on the floor; Item 5 = standing to seated on a bench; Item 6 = standing on solid/stable surface; Item 7 = standing on soft/semi-unstable surface; Item 8 = standing, eyes closed; Item 9 = standing, kicking a ball with the right foot; Item 10 = standing, kicking a ball with the left foot; Item 11 = standing, catching a ball thrown towards him/her; Item 12 = walking for five meters; Item 13 = transposing of obstacles; Item 14 = going up stairs; Item 15 = going downstairs; Item 16 = going up a ramp with a minimal inclination of 45°; Item 17 = going down a ramp with a minimal inclination of 45°; Item 18 = motor stims; I-CVI = Item-level content validity index; S-CVI/UA = Scale-level content validity index/universal agreement calculation method; S-CVI/Ave = scale-level content validity index/averaging calculation method; PRE = proportion of relevance of each expert.

The title and instructions of GMA-AUT checklist obtained I-CVI of 1.00 in round 1 and the agreement rate remained still in round 2. Visual layout of the instrument obtained I-CVI of 0.88 in round 1, and 1.00 in round 2, being then considered clear by all the experts. The final draft of the GMA-AUT checklist is available in Appendix 1 and Appendix 2 (Portuguese version).

Discussion

Content validity

In this study, we evaluated the content validity of the GMA-AUT checklist, developed for gross motor assessment in children and adolescents with ASD. The committee of experts considered valid the content of GMA-AUT for gross motor ability assessment in children and adolescents with ASD, between four and 18 years old, with excellent I-CVIs.

A recent review on motor competences assessments for children with ASD or intellectual disabilities (ID) included ten instruments.¹⁸ The Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2), followed by the Test of Gross Motor Development-2 (TGDM-2), were the most psychometrically appropriate motor competency assessments for children with ID. Although current literature defends content validation of instruments,^{13,19} the instruments for gross motor assessment included in the systematic review did not present content validation in their process of validation.¹⁸

Valentini²⁰ translated and investigated the content, criteria, and construct validity and reliability of the TGMD-2 for Brazilian children with atypical development. The result of agreement for language clarity of motor items was 0.96 and 0.89 for pertinence. In the present study, validity of motor items was 0.99.

In a systematic review on validity and reliability of motor assessments in children and adolescents, content validity was the less investigated measurement property.¹⁹ The authors reiterate that in batteries of abilities which are well established in the field as the TGDM, it is possibly assumed that content validity has already been tested. However, this supposition could not be made because this test, for example, evaluates abilities that have limited relevance in individuals from other countries.^{21,22} Still, they suggest that experts might provide their evaluation regarding the applicability

of an instrument in population of interest before this instrument be used in a population.¹⁹

Adjustments

After round 1, item 8 (standing, eyes closed) and item 18 (motor stims) from the first draft were considered invalid by half of the experts. They justified that few children would accept to keep the eyes closed because of the sensorial alterations that it causes. The dependence on vision in the static balance of children with ASD has been confirmed in previous studies in which moderate severity ASD children were asked to close their eyes or wear a blindfold during balance assessments.^{23,24} However, this kind of assessment (with eyes closed) can be difficult for children with more severe ASD, since static assessments of postural control are influenced by patient's motivation, focus, cooperation and effort²⁵ and may be a problem when applied in a population that often presents communication, learning, attention and behavioral problems.

In this way, with the intention of using a methodology that would allow the assessment of balance in minimally cooperative patients²³ and could be performed even by subjects with limited cognitive capacity without the need for a direct command, we kept item 2 (standing on a solid/stable surface) and item 3 (standing on a soft/semi-unstable/soft surface), as these items are subject to observation and can be performed spontaneously by the patient. We believe that these items are relevant as children with ASD have greater postural sway on unstable surfaces compared to children with typical development.²⁶

Regarding motor stims/stereotypies, there was divergence among experts. Three professionals justified that such item should be excluded, as it did not concern motor skills directly. This disagreement also occurs in literature because there is controversy on the causes of this behavior. Although no model got major support between specialists, Applied Behavior Analysis, which is the predominant behavioral theory currently, suggests that motor stims are maintained by automatic reinforcement or social interactions.²⁷ A second view, which is postulated by homeostatic theories, suggests that there is an optimal level of stimulus for each individual and motor stimulating have a compensatory regulatory function in both less stimulating and overstimulating environments.^{28,29} Lastly, another approach says that

motor stims are seen as a motor disorder which does not depend on functional interpretation, but it reflects involuntary actions of a deregulated motor control system.^{30,31} Thus, due to the lack of consensus among experts and in the literature, and since the influence of motor stims on development is not fully elucidated, the item about motor stims was removed from the instrument.

In addition to the removal of those items, two experts suggested the inclusion of jump assessments, with item 13 being added in the second draft (vertical jump). Children with ASD have several deficits in gross motor skills, such as running, jumping and sliding.³²⁻³⁴ The decreased motor function in skills involving lower limbs mimics motor patterns commonly found in hypotonia,³⁵ what can affect dorsiflexion and plantar flexion control and function.³⁶ Apparently, these changes continue into adulthood, once young adults with ASD have lower angles of flexion of the hips and knees and greater angles of dorsiflexion of the ankle when compared to participants without ASD in long jump assessment, showing the existence of a pattern of inefficiency in the use of lower limbs' distal joints.³⁶

In round 2, only one expert presented PRE of 88%, while all others presented PRE of 100%, considering all valid items. Expert 3 considered less valid items 9 and 10 (standing, kicking a ball with the right foot/left foot). The expert sustained the same suggestion from round 1 that the nomenclature "dominant foot" and "non-dominant foot" should be used. However, we understand that the determination of foot dominance involves a prior assessment, which we cannot assume will be carried out prior to the application of the GMA-AUT. So, we chose to keep the nomenclature referring to laterality. Moreover, other study³⁷ indicates that the process of lateralization and dominance of lower limbs is completed around the sixth year of life, then if this item was modified following the expert's suggestion, it could not be applied to the age group for which the assessment is intended (from four to 18 years old).

Differentials

Motor abnormalities in ASD manifest early in childhood and often precede the emerging of primary deficits, besides presenting intrinsic relationship with central characteristics of ASD as they affect the learning of perceptual motor skills and limit social interactions.^{3,4}

Wilson et al.⁹ systematically reviewed the literature to describe standardized motor assessments that are most commonly used in children with ASD. They indicated that the main global limitation of these assessments is the absence of children with ASD in the sample of the included studies, which affects validity and reliability of these measures when assessing this population. Similar review concluded that assessments developed specifically for this population showed greater feasibility, what corroborates with the importance of using population-specific tools.¹⁸

Another limitation of the assessments was in scoring only motor skills, without describing motor patterns.⁹ This was a major concern in the development of the GMA-AUT, which aims to provide qualitative information about how the individual performs the motor task (through a quantitative scale) and not just informing whether the individual was able to perform it or not.

In this way, it is important to note that about 70 to 75% of children with ASD demonstrate a co-occurrence of moderate to severe ID,³⁸ and these children obtain lower values on tests of motor skills when compared to typical children of the same age.³⁹ For this reason, Wilson et al.⁹ suggest that motor assessments in this population should not use methods which require cognitively complex tasks, but should approach different levels of intellectual and behavioral functions. These topics guided the development of an instrument which has an observational nature. Also, the division of the checklist items into two sections aimed to appraise both motor and social-behavioral issues.

In this context, the development of a specific standardized assessment for children with ASD is important both in the outpatient setting, to direct motor intervention and to measure treatment results, and in the context of scientific production, to allow the determination of motor patterns for ASD, which enables further studies on the relationship of these patterns with the concepts of motor cognition and its role in the social skills of individuals with ASD.^{9,40}

Limitations

We understand that an observational assessment of the spontaneous motion of children and adolescents with ASD, which aims to embrace all levels of cognitive and behavioral function, may have limited the assessment of other skills that might be important such

as the unipodal balance assessment and the horizontal jump, for example. However, we believe that these skills are indirectly included in the evaluation of items such as kicking a ball (which requires unipodal support while the contralateral foot performs the kick) and vertical jump (which assesses the ability to provide impulse).

Content validation, according to the COSMIN criteria,¹⁰ can also be performed on the target population. However, we considered that this requirement would not be applicable as the target population in this study are children and adolescents with ASD. Another COSMIN's requirement that was not applied refers to recordings and transcripts of meetings and interviews, which did not occur since the questionnaire for content validity was closed-ended (but with empty space for writing suggestions), and it was replied by e-mail.

Conclusion

The content proposed by the GMA-AUT checklist was considered valid from the perspective of experts in the field. Nevertheless, it is noteworthy that it is still necessary to assess the reliability of the GMA-AUT to be used both in clinical practice and in research. Currently, the GMA-AUT checklist is available as a support material in the teaching-learning process in the academic context of physical therapy.

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Authors' contribution

All authors were responsible for conceptualization, and resources were provided by GMG and CTC. TEH, LB and CTC were responsible for the methodology;

TEH, LB and GMG, for validation and analysis; TEH, for investigation, data curation, write of the original draft and project administration. All authors reviewed and edited the original draft, and CTC supervised it.

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