# Socio-Culturally Different Motor Skills of Czech Children with ASD Aged 7–10 Years Assessed by the Test TGMD–3

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## *ABSTRACT*

*Background*: Autism spectrum disorders (ASD) are associated with delayed gross motor development and limited ability to imitate human movements. The Test of Gross Motor Development – Third Edition (TGMD-3) is declared for use in children with ASD (Ulrich; 2013, 2019). TGMD-3 was developed in the US and included culturally different elements, such as the Striking of the stationary ball and Underhand throw, performed according to US practice. The pilot study aimed to assess whether the diagnostic tool TGMD-3 is a reliable tool in the Czech environment for diagnosing motor skills in children with ASD. The aim of the research was 1) to record and describe the reactions of children with ASD to culturally different elements in the motor test TGMD-3 and 2) to compare their ratings with the other items of this subtest.

*Methods*: This pilot study included participants (n = 16, 1 girl, age range 7–10 years, Mage=9.125, SD=1.89 years) with ASD. The participant's physical performance was assessed with the TGMD-3 motor test (Ulrich, 2016) using visual support (Allen et al., 2017) according to the instructions of the Examiner's Manual Test TGMD-3 by four independent examiners. The qualitative assessment of the participant's behavior was evaluated using Flanagan's CIT (Critical Incident Technique) principle, verified for pedagogy and sports areas in the Czech Republic (Válková et al., 2012).

*Results*: The manifest indicators of locomotor and ball skills were significant ($p < .001$). The pilot study confirmed the factorial structure of the Test TGMD-3. The TGMD-3 showed good levels of internal consistency and also interrater and intrarater reliability. The limited ability to imitate (characteristic of children with ASD) probably significantly influenced the culturally different performance of the Underhand throw movement element. The culturally different skill Striking of the stationary ball had a very motivating effect and can be described as the so-called "novelty effect," which is known in the TD population aged 7–10 years.

*Conclusion*: This pilot study confirms the factorial structure and applicability of the TGMD-3 motor skills test in the Czech sociocultural environment for children with ASD (with modification of the administration process based on the principles of structured learning (Možná & Válková, 2022) and visual support (Allen et al., 2017)). The limiting factor was the deliberate selection of the group and the small number of participants. Further cross-cultural studies of the TGMD-3 can potentially expand the current diagnostic methods of motor skills in children with ASD.

**Keywords:** autism spectrum disorders, ASD, motor, TGMD-3, Socio-culturally different skills

## INTRODUCTION

Autism spectrum disorders (ASD) are neurodevelopmental diseases characterized by impairments in communication, social communication, and stereotyped restricted behavior and interests (APA, 2015; MKN-10, 2021). ASD is associated in up to 80% with deficits and delays in motor development (Sansi et al., 2021). Motor difficulties are not among the diagnostic criteria of ASD (APA, 2015; MKN-10, 2021) and are not described in every individual with ASD (APA, 2015; Dewey et al., 2007; MKN-10, 2021; Wang, 2022). Nevertheless, motor difficulties have been referred to since the 1950s in the original article by Leo Kanner (Kanner, 1943) and Hans Asperger (Asperger, 1943). In addition to the widely reported gross and fine motor deficits (Asperger, 1943; Cairney et al., 2019; Colombo-Dougovito & Block, 2019; Crucitti et al., 2019; Čadilová et al., 2012; Fahimeh et al., 2020; Kanner, 1943; and review, e.g., Wang, 2022) authors of research studies in children with ASD often also note a limited ability to imitate movements (Liu et al., 2014; Smith & Bryson, 1994).

Appropriate diagnostic tools for routine use in practice are a prerequisite for early intervention in motor skills. This is crucial both from the point of view of the need for comprehensive care for these children and for increasing their quality of life (Brusseau et al., 2018; Colombo-Dougovito, 2017; Chan et al., 2016; Hulteen et al., 2015; Palmer et al.., 2020). Standardized motor tests are especially suitable for accurate and repeatable diagnosis. (Psotta, 2014) In the Czech Republic, of the standardized motor tests, only the Movement Assessment Battery for Children, 2nd edition (MABC-2) test has established norms. The normative sample was generated from the typically developing children (TD) population. (Psotta, 2014)

The TGMD-3 test (Ulrich, 2013, 2017, 2019) was designed in the USA, and the norms for the population of TD children were also created in the sociocultural environment there. The test is declared for use in children with ASD (Magistro et al., 2018; Ulrich, 2019). The TGMD-3 test consists of two subtests – locomotion and ball skills. The Ball Skills subtest contains culturally different elements, such as the Two-hand strike of a stationary ball and the Underhand throw, performed according to US customs. For these reasons, modifications have been created in the European sociocultural environment in some states (Wagner et al., 2017), which do not contain these elements typical of the US environment.

The purpose of the pilot study was to assess whether the TGMD-3 diagnostic tool can be used in the Czech sociocultural environment to diagnose motor skills in children with ASD, thus expanding the possibilities of motor skills evaluation tools for this population. Furthermore, to summarize the data for effectively selecting a suitable variant of the TGMD-3 test, which would be crucial in further assessing motor skills on a more extensive research sample. The aim of the research was 1) to record and describe the reactions of children with ASD to culturally different elements in the ball skills subtest of the TGMD-3 motor test and 2) to compare their ratings with other items of this subtest.

## METHODS

### *Participants*

This pilot study included participants (n = 16, 1 girl, age range 7-10 years, $M_{age}$=9.125, SD=1.89 years) with ASD. All 16 participants with ASD were included in the study because they met the participation criteria: age 7–10 years, officially diagnosed with ASD (documented by a medical report), do not suffer from a sensory disorder such as vision and hearing disorders, and have a place of permanent residence in the Czech Republic according to their date of birth.

The research sample is gender unbalanced due to the recruitment method of participants for this study, which took place during restrictive measures during the COVID-19 pandemic. Legal guardians enrolled their children in this research with voluntary participation. At the same time, the ratio between included boys and girls in this research confirms the uneven distribution of ASD in the population of boys and girls, which has been repeatedly declared worldwide. (APA, 2015; MKN-10, 2021; Zeidan et al., 2022)

### *Procedures*

This pilot study is part of a more extensive research project, *Verification of motor skills assessment tools in Children with autism spectrum disorders* - MUNI/A/1534/2020, supported by a specific Faculty research grant from Masaryk University Sport and Education. A pilot study was conducted to verify the use of the TGMD-3 diagnostic tool on a population of children with ASD. Special emphasis was placed on the culturally different elements of the TGMD-3 test. As part of this project, information booklets are created for people caring for children with ASD, as well as doctoral and diploma theses that focus on the issue of standardized motor tests that are suitable for this specific population of children with ASD (Možná, 2022; Podhorná, 2022). The project was approved in its entirety by the Ethics Committee of Masaryk University.

Participants were assessed with the TGMD-3 motor test (Ulrich, 2013, 2019) using visual support (Allen et al., 2017). Each participant completed one practice, and then two scored trials. Scores were recorded only during the two scored trials. Four independent examiners assessed the participants‘ physical performance according to the instructions of the Examiner‘s Manual Test TGMD-3 (Ulrich, 2019). All raters had university degrees in physical education and sport, exactly two with a bachelor‘s degree and two with a doctoral degree. All team members required 95% interobserver agreement on a pre-coded sample of data.

The first step of this study was a meeting with the parents of children with ASD to collect data about the participant‘s health status (personal and family history) and to evaluate the fulfillment of the

entry criteria of the research. Furthermore, a functional communication and motivational strategy was established for each participant with ASD. Attention was also focused on choosing a suitable environment for performing the motor test and deciding on the presence of other persons during the motor test - parents, teachers, or assistants. Insufficient time before implementing the TGMD-3 motor test became parents' information about the course of the testing, which also contained graphically processed information for children with ASD. This information included a photo of the test team members. This step was intended to minimize distractions that could potentially limit participants' cooperation with PAS. To increase the feasibility of the TGMD-3 test were used motivational elements and strategies (especially the implications of structured learning and the TEACCH program (Možná, 2022)). These implications have already been verified in the population of children with ASD in the Czech Republic using standardized motor tests (Možná & Válková, 2022).

Before starting the testing process, the trained administrator filled in the data about the child (age and gender of the child, date of testing, laterality); subsequently, following the instructions of the Examiners manual (Ulrich, 2019), the TGMD-3 test was performed.

## TEST OF GROSS MOTOR DEVELOPMENT—3RD EDITION (TGMD-3)

This test includes two parts: a performance test and a checklist. The TGMD-3 (Ulrich, 2019) assessed fundamental motor skills on six locomotors and seven ball skills. The participants were scored according to the original scoring process of the TGMD-3. "For each of the 13 TGMD-3 movement tasks, three to five criteria are formulated to enable a differentiated assessment of the movement quality" (Wagner et al., 2017). One practice trial and two evaluated trials are always performed. If the child performs the given skill correctly according to the prescribed criteria, he gets 1 point. If the given criterion is missing in the attempt, 0 points are awarded. When evaluating the test, the sum is determined by the raw skill score. A maximum of 46 points can be obtained in the Locomotor Skills subtest. A maximum of 54 points can be obtained in the Ball Skills subtest (Ulrich, 2019).

The TGMD-3 still needs to establish standards for the Czech population, and an official Czech translation is also missing. Original recording sheets in English were used in this study. A publicly available video demonstrating the administration of the TGMD-3 motor test by test author Professor Dale Ulrich (https://www.youtube.com/watch?v=9WggHyZpXl0) served as a model for the test administrators to demonstrate the motor tasks. According to the prescribed instructions, the administrator demonstrated each movement skill to the participant.

## SOCIO-CULTURALLY DIFFERENT MOTOR SKILLS OF TGMD-3

Researchers in some countries are deliberately modifying the motor skills of TGMD-3. (Duncan et al., 2019; Tamplain et al., 2019; Wagner et al., 2017). The reasons for changing the TGMD-3 test are: improving the feasibility of the test in the school environment (Tamplain et al., 2019) or sociocultural differences in the background. (Wagner et al., 2017) Wagner et al. (2017) excluded the movement task "Two-hand strike of a stationary ball" because they "did not see complex phylogenetic relevance within this particular task" (p. 32).

### TWO-HAND STRIKE OF A STATIONARY BALL

Movement task Two-hand strike of a stationary ball evaluates the child's skill with five criteria. 1) Does the preferred hand grip the bat over the non-preferred hand; 2) makes the non-preferred hip/shoulder point straight; 3) if does the hip and shoulder rotate back and forth while performing the movement; 4) does the child take steps with the non-preferred leg; and 5) does the child hit the ball, so that headed straight ahead. (Ulrich, 2019)

### UNDERHAND THROW AND OVERHAND THROW

The movement task Underhand throw evaluates the skill using four criteria. 1) If the preferred hand swings down and back, reaching behind the trunk; 2) the child steps forward with the foot opposite the throwing hand; 3) if the ball is tossed forward, hitting the wall without a bounce; and 4) hand follows through after ball release to about chest level. (Ulrich, 2019)

The movement task Overhand throw also evaluates the skill based on four criteria. 1) If the windup is initiated with a downward movement of hand and arm, 2) hip and shoulder rotate to the point where the non-preferred side faces the wall, 3) if the child steps with the foot opposite the throwing hand towards the wall and 4) throwing hand follows through after ball release across the body towards the hip on the non-throwing side. (Ulrich, 2019)

The underhand throw is common in the Czech Republic. However, its execution is culturally different. Among the criteria mentioned above, the criteria relating to the leveraging phase differ. The design is typical for the US environment (especially characteristic of baseball – a traditional sport).

### QUALITATIVE EVALUATION OF CULTURALLY DIFFERENT ELEMENTS IN TEST TGMD-3

The qualitative assessment of the culturally different elements of the TGMD-3 test is based on the basic principle of the CIT concept (Flanagan, 1954), i.e., the application of process evaluation based on Flanagan's critical cases (Flanagan, 1954). In his original work, Flanagan (1954) defines a critical case as "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (p. 327).

The scoring evaluation process corresponds to DIC-CIT (Válková et al., 2012), where behavioral manifestations leading to successful mastery of the skill are coded plus, and behavioral manifestations hindering successful mastery of execution are coded minus.

## RESULTS

The pilot study results are also presented in case studies of individual participants, which allow better descriptive and comparative possibilities than the only statistical numerical expression on a small research sample (especially for further research in a heterogeneous population of children with ASD). Another reason for the simultaneous casuistic interpretation of the results was, in addition to the small size of the research sample, also the deliberate selection of participants, which was related to the restrictive measures in the Czech Republic during the COVID-19 pandemic.

## SUMMARY OF QUANTITATIVE RESULTS FROM CASE STUDIES OF PARTICIPANTS WITH ASD

The summary results of the TGMD-3 motor test of the research group shows in Table 1.

**Table 1.** Descriptive term of the test TGMD-3

| Descriptive Term | Total |
|---|---|
| Impaired od Delayed | 3 |
| Borderline Impaired or Delayed | 6 |
| Below average | 2 |
| Average | 5 |

The results of the Descriptive term of the overall result of the TGMD-3 show that children with ASD aged 7-10 years can perform motor skills test with a modification of the administration process based on the key principles of structured learning and the TEACCH program (Možná & Válková, 2022) and visual support (Allen et al., 2017). The TGMD-3 with visual support protocol (Allen et al., 2017) and implications of the principles of structured learning and the TEACCH program (Možná & Válková, 2022) show good levels of internal consistency and also interrater and intrarater reliability. The manifest indicators of locomotor and ball skills were significant ($p < .001$). The pilot study confirmed the factorial structure of the Test TGMD-3.

## SUMMARY OF QUALITATIVE RESULTS FROM CASE STUDIES OF PARTICIPANTS WITH ASD

### *Responses of children with ASD to culturally different items on the TGMD-3 motor test*

The reactions of children with ASD were recorded on a video recording, which was subsequently analyzed repeatedly. The culturally different element of the Two-hand strike of a stationary ball was motivating (according to CIT) for participants with ASD aged 7-10 years. In the research group (n=16), only one participant had an adverse child reaction to this task. The following paragraph describes this behavioral process in detail: Participant 3.

### *Participant 3- qualitative description of behavior*

The child lost motivation to test for the Skip movement task in the Locomotor subtest when he lost motivation during the execution of this movement task (he did not perform the second evaluated trial). The child's parent was present during the testing. The procedure for motivating the child and the possible possibility of interrupting/postponing the TGMD-3 testing was consulted with the parent. This situation was followed by an interruption of testing for 9 minutes and 40s (subtracted from the video recording), supplemented by motivational elements and a short rest. The Horizontal jump and Slide items also record refusal to perform a movement task. Even in the movement task, the Two-hand strike of the stationary ball does not motivate the child to perform the activity. He throws the bat around the testing room and repeatedly kicks the tripod. According to the parent, this behavior is not a manifestation of anger but a reluctance to perform the given activity. The child communicates verbally in a minimal, limited way. He usually communicates with the

parent using signs, gestures, and possibly one-word expressions. The participant was presented with other following test movement tasks, and he spontaneously participated only in the item: Kick a stationary ball, which he performed even after the second evaluated trial in the following six unrated trials. He continued with motor testing with interest and performed the Underhand Throw and Overhand Throw tasks without needing additional motivational elements. However, it did not meet the defined monitoring criteria, and both items were scored as 0.

From the research group, the remaining 15 children performed the movement task Two-hand strike of the stationary ball without 2) loss of motivation during the execution of this movement task. However, it was noted in three participants 3) loss of motivation to continue the implementation of the TGMD-3 test and start the next test task. In all three cases, the reason was the child's preoccupation with this activity, which he did not want to end. In these three cases mentioned above, staying longer with this activity was necessary and performing other unrated attempts. This need was most prominently noted in participant 4.

***Participant 4- qualitative description of behavior***

This participant was very successful in both evaluated attempts. In the first attempt, he only failed to meet the criterion: non-preferred hip/shoulder faces in the straight-ahead direction. On the second attempt, he already achieved the maximum possible score for this item. After this attempt, he refused to end the activity. Thus, it was necessary to continue the non-scored trials for another 5 minutes and 20 seconds (subtracted from the video recording). After this time, he was already willing to proceed with the TGMD-3 test without using other motivational elements. There was no pressure on the child to finish the Two-hand strike of the stationary ball activity, only the child was motivated verbally, and by the presentation of the next movement element that followed. Based on the initial interview with the parent, it was necessary to take into account the fact that the participant had repeated bouts of anger with self-aggressive manifestations in the past. He participated in the testing accompanied by a parent and an intact sibling. The child's motivation process was consulted with the parent during testing.

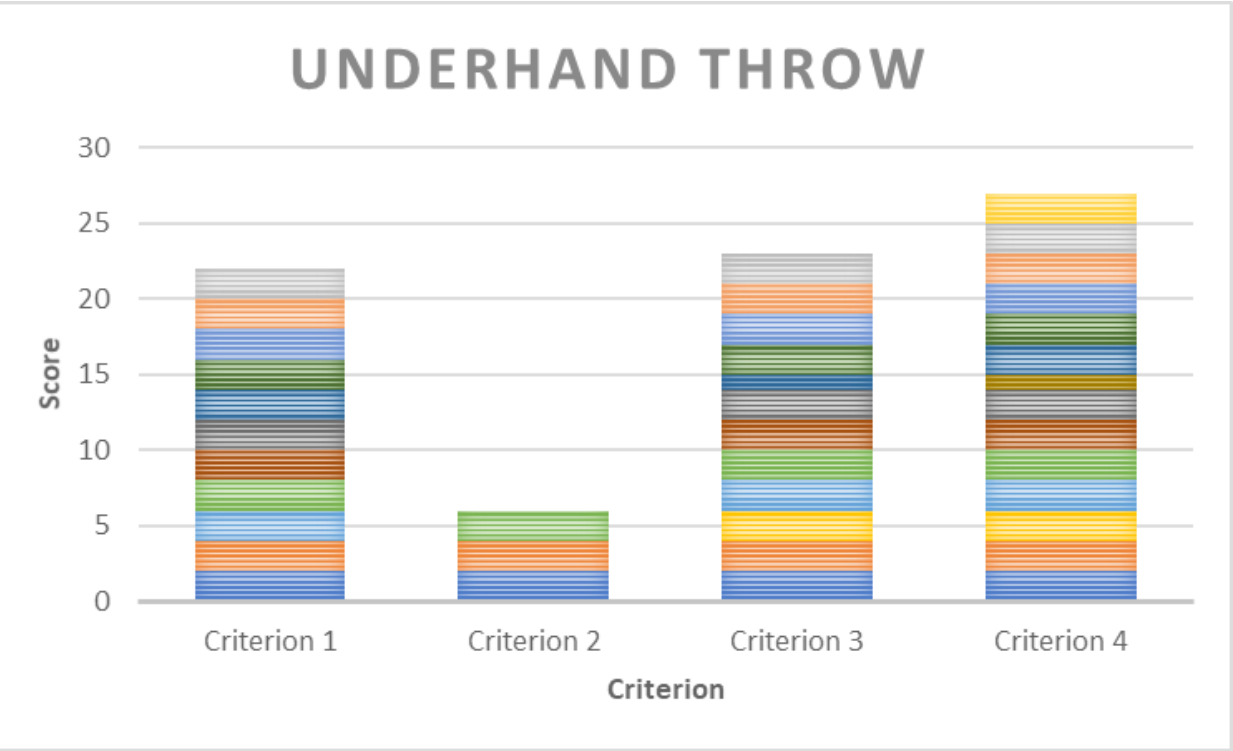
## COMPARISON OF THE ASSESSMENT OF CULTURALLY DIFFERENT ELEMENTS IN THE BALL SKILLS SUBTEST IN THE TGMD-3 TEST WITH OTHER ITEMS OF THIS SUBTEST

For this heterogeneous population of children with ASD, the comparison of the assessment of culturally different elements in the Ball skills subtest in the TGMD-3 test includes the necessity to consider not only the quantitative expression within the standardized TGMD-3 test, which gives the appropriate score for each movement task. It is also necessary to collect other qualitative data to complement this information. As part of implementing the TGMD-3 ball skills subtest, according to the CIT scoring (Flanagan, 1954; Válková, 2012), a highly variable ability to concentrate in the performance of movement tasks was recorded in the participants, associated with fluctuations in the performance of movement tasks. It was also possible to observe a specific "novelty effect" as a motivational factor (according to CIT), typical for the TD population aged 7-10 years.

When evaluating the ball skills subtest, the most culturally different performance was manifested in the movement task Underhand Throw. Only three participants met the second evaluated

criterion: the child steps forward with the foot opposite the throwing hand (Ulrich, 2019). These 3 participants achieved the maximum score in both trials evaluated. In total, they received 2 points (each participant). On the contrary, the remaining 13 participants did not receive any points for this criterion in both evaluated trials. Detailed results are visualized in Chart 1.

**Figure 1.** Total summary of scores of the movement task Underhand Throw (Ulrich, 2019).




Four criteria of the movement task Underhand Throw (Ulrich, 2019, p.19):

1. "Preferred hand swings down and back, reaching behind the trunk;
2. Steps forward with the foot opposite the throwing hand;
3. Ball is tossed forward, hitting the wall without a bounce;
4. Hand follows through after ball release to at least chest level."

## DISCUSSION

Cross-cultural validity and modifications of the TGMD-3 test for use in sociocultural areas other than the US were discussed by Duncan et al., 2019; Tamplain et al., 2019; Wagner et al., 2017. The reasons for changing the TGMD-3 test were: improving the feasibility of the test in the school environment (Tamplain et al., 2019) or non-complex phylogenetic relevance and sociocultural differences of the area (Wagner et al., 2017).

In an article by Valentini, Zanella, and Webster (2017), content validity is assessed in 597 Brazilian children aged 3–10 years. In addition to evaluating the test's construct validity, the authors addressed the cross-cultural translation of the TGMD-3 into Brazilian Portuguese. Intrarater and interrater reliability was described as good to excellent.

In Germany, Wagner, Webster, and Ulrich (Wagner et al, 2017) used a German translation of the TGMD-3 to assess the motor skills of 189 TD children. In this version, the test task Two-hand

strike of a stationary ball, has been removed. According to the authors' conclusion, test-retest and intrarater reliability were rated as excellent.

The validity of the test was verified on the population of children with ASD directly by its author, Professor Ulrich Dale (2019), who published the results in the Examiner's Manual Test TGMD-3 (p. 64). A sample of TD children based on age, sex, race, and ethnicity was compared with a sample of 33 children and ASD. Intrarater and interrater reliability were also described as good to excellent. The results, therefore, correspond to the results we found in this pilot study of children with ASD aged 7-10 years in the Czech sociocultural environment.

## CONCLUSION

A limiting factor for the possibility of generalizing individual findings to the entire population of children with ASD aged 7-10 years in the Czech sociocultural environment is mainly the intentional selection of the research group and the small number of participants in this pilot study. The size of the research sample and the choice of participants were influenced by restrictive measures in the Czech Republic during the COVID-19 pandemic.

In addition to the standardized evaluation of the TGMD-3 test in children with ASD, we recommend expanding the data collection with additional qualitative evaluation. The risk that a motor test may be significantly influenced by non-motor factors that prevent the child from demonstrating actual motor ability is undoubtedly higher in children with ASD than in children of the general population of the same age. Seemingly banal details, which are not commonly encountered in the population of TD children aged 7–10, can affect the course of the situation (according to CIT) (non-preferred color of the ball, different tennis racket than the one the child is using).

In conclusion, it is necessary to mention that even in this small sample of children with ASD in the Czech Republic, it was possible to observe a specific "novelty effect" as a motivational factor (according to CIT), which is typical for the TD population aged 7-10 years. It is advisable to keep this phenomenon in mind and verify it in further research on a more extensive set of participants.

This pilot study demonstrated the feasibility of the test TGMD-3 (Ulrich; 2013, 2019) across children with ASD in the Czech sociocultural environment – with a modification of the administration process based on the principles of structured learning (Možná & Válková, 2022) and visual support (Allen, 2017). The factorial structure and applicability of the TGMD-3 motor skills test in the Czech sociocultural environment for children with ASD were confirmed.

Further research using the diagnostic instrument TGMD-3 in children with ASD in the Czech Republic, as well as the standardization of this instrument in the Czech population, has the potential to expand diagnostic methods in the field of motor skills and thus contribute to the possibilities of evaluating motor performance in children with ASD.

## REFERENCES

American Psychiatric Association (APA). (2015). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Allen, K. A., Bredero, B., Van Damme, T., Ulrich, D. A., & Simons, J. (2017). Test of gross motor development-3 (TGMD-3) with the use of visual supports for children with autism spectrum disorder: Validity and reliability. *Journal of Autism and Developmental Disorders, 47*(3), 813-833. doi:10.1007/s10803-016-3005-0

Asperger, H. (1943). *‚Autistic pychopathy' in childhood.* Leiter der Heilpädagogischen Abteilung der Klinik.

Brusseau, T. A., Hannon, J. C., Fu, Y., Fang, Y., Nam, K., Goodrum, S., & Burns, R. D. (2018). Trends in physical activity, health-related fitness, and gross motor skills in children during a two-year comprehensive school physical activity program. *Journal of Science and Medicine in Sport*, 21(8), 828–832.

Crucitti, J., Hyde, C., & Stokes, M. A. (2019). Hammering that nail: varied praxis motor skills in younger autistic children. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-019-04136-4.

Dewey, D., Cantell, M. & Crawford, S. G. (2007). Motor and gestural performance in children with autism spectrum disorders, developmental coordination disorder, and/or attention deficit hyperactivity disorder. *Journal of the International Neuropsychological Society*, 13(2), 246–256.

Duncan, M. J., Roscoe, C. M. P., Noon, M., Clark, C. C. T., O'Brien, W., & Eyre, E. L. J. (2019). Run, jump, throw and catch: How proficient are children attending English schools at the fundamental motor skills identified as key within the school curriculum*? European Physical Education Review*, 26(4), 814–826.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin,* 51(4), 327-358.

Hulteen, R. M., Ridgers, N. D., Johnson, T. M., Mellecker, R. R., & Barnett, L. M. (2015). Children's movement skills when playing active video games. *Perceptual and Motor Skills*, 121(3), 767–790

Chan, C., Ha, A., & Ng, J. Y. (2016). Improving fundamental movement skills in Hong Kong students through an assessment for learning intervention that emphasizes fun, mastery, and support: The aþ FMS randomized controlled trial study protocol. *SpringerPlus*, 5(1), 724–736.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child,* 2, 217-250.

Liu, T., Hamilton, M., Davis, L. & ElGarhy, S. (2014) Gross motor performance by children with autism spectrum disorder and typically developing children on TGMD-2. *Journal of Child and Adolescent Behaviour*, 02(01), 1–4. doi.org/10.4172/jcalb.1000123

Magistro, D., Piumatti, G., Carlevaro, F., Sherar, L. B., Esliger, D. W., Bardaglio, G., Magno, F., Zecca, M., & Musella, G. (2018). Measurement invariance of TGMD-3 in children with and without mental and behavioral disorders. *Psychological Assessment, 30*(11), 1421–1429. https://doi.org/10.1037/pas0000587

Mezinárodní klasifikace nemocí (MKN-10). (2022). *Mezinárodní klasifikace nemocí a přidružených zdravotních problémů: desátá revize.* Tabelární část. Aktualizované vydání. ÚZIS ČR. www.uzis.cz/katalog/klasifikace/mkn.

Možná, T. (2022). *Evaluace motorických kompetencí testem MABC2 u dětí s PAS.* [Rigorózní práce, Masarykova univerzita]. Archiv závěrečných prací MUNI. https://is.muni.cz/th/haao3/

Možná, T. & Válková, H. (2022). *MABC-2 pro děti s poruchou autistického spektra*. Munipress.

Palmer, K. K., Chinn, K. M., & Robinson, L. E. (2017). Achievement goal theory in motor skill interventions: A systematic review. *Sports Medicine*, 47(12), 2569–2583.

Podhorná, H. (2022). *Analýza vybraných motorických ukazatelů u dětí s PAS v českém prostředí dle testové baterie TGMD-3*. [Diplomová práce. Masarykova univerzita]. Archiv závěrečných prací MUNI. https://is.muni.cz/th/sxo8m/

Rintala, P. O., Sääkslahti, A. K., & Iivonen, S. (2017). Reliability assessment of scores from video-recorded TGMD-3 performances. *Journal of Motor Learning and Development*, *5*(1), 59-68.

Sansi, A.; Nalbant, S., & Ozer, D. (2021) Effects of an Inclusive Physical Activity Program on the Motor Skills, Social Skills and Attitudes of Students with and without Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 51(7), 2254-2270. https://doi.org/10.1007/s10803-020-04693-z

Smith, I. M., & Bryson, S. E. (1994). Imitation and action in autism: A critical review. *Psychological Bulletin*, 116(2), 259–273. https://doi.org/10.1037/0033-2909.116.2.259

Tamplain, P., Webster, E. K., Brian, A., & Valentini, N. C. (2019). Assessment of motor development in childhood: Contemporary issues, considerations, and future directions. *Journal of Motor Learning and Development*, 8(2), 391–409. https://doi.org/10.1123/JMLD.2018-0028

Ulrich, D. A. (2013). The test of gross motor development-3 (TGMD-3): Administration, scoring, and international norms. *Spor Bilimleri Dergisi*, *24*(2), 27-33.

Ulrich, D. A. (2017). Introduction to the special section: Evaluation of the psychometric properties of the TGMD-3. *Journal of Motor Learning and Development*, *5*(1), 1-4.

Ulrich, D.A. (2019). *Test of gross motor development—3rd edition (TGMD-3) Examiner´s Manual*. Pro-ed, Inc.

Valentini, N. C., Zanella, L. W., & Webster, E. K. (2017). Test of Gross Motor Development—Third Edition: Establishing Content and Construct Validity for Brazilian Children, *Journal of Motor Learning and Development*, 5(1), 15-28. Retrieved Apr 17, 2023, from https://doi.org/10.1123/jmld.2016-0002

Válková, H. Bartošová, R., Ahmetaševič, A. (Eds.) (2012). *Manuál pro hodnocení inkluzivních vyučovacích jednotek tělesné výchovy: DIC-CIT pro ATV* Olomouc: Univerzita Palackého.

Wagner, M. O., Webster, E. K., & Ulrich, D. A. (2017). Psychometric properties of the Test of Gross Motor Development, (German translation): Results of a pilot study. *Journal of Motor Learning and Development*, *5*(1), 29-44.

Zeidan, J., Fombonne, E., Scorah, J., Ibrahim, A., Durkin, M. S., Saxena, S., ... & Elsabbagh, M. (2022). Global prevalence of autism: a systematic review update. *Autism Research*, 15(5), 778-790.

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