Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

METRIC CHARACTERISTICS OF THE TEST OF GROSS MOTOR DEVELOPMENT (TGMD 3)

METRIJSKE KARAKTERISTIKE TESTA ZA PROCJENU GRUBIH MOTORIČKIH SPOSOBNOSTI (TGMD 3)

Senad Mehmedinović*, Vesna Bratovčić, Edina Kuduzović, Benjamin Avdić, Lama Kožljak

[1]Faculty of Education and Rehabilitation, University of Tuzla
Univerzitetska 1, 75000 Tuzla, Bosnia and Herzegovina

Original Scientific Article

Received: 20/09/2021
Accepted: 10/12/2021

ABSTRACT

The aim of this study was to determine metric characteristics of the Test of Gross Motor Development (TGMD 3). The study included 146 children from Bosnia and Herzegovina, aged 3-10,4 (6,80 ± 2,23 years; 46,6% male; 53,4% females). Based on the obtained research results it can be concluded that Test of Gross Motor Development (TGMD-3) has satisfactory reliability and internal consistency for children aged 3 to 10 years. Mutual correlations confirm the homogenity of the scale. Based on results of Kolmogorov-Smirnov test, Test of Gross Motor Development is not sensitive for subjects included in this study. The obtained results of the confirmatory factor analysis of this model show a partial agreement of the assumed model with the data (h^2 = 108.17, df = 64, h^2 / df = 1.69, TLI = 0.86, CFI = 0.72, NFI = 0.72., RMSEA = 0.07 CI = 0.04-0.09). The data was analyzed with the SPSS 20 software (with the AMOS package). The limitations in the research are the respondents, because due to the epidemiological situation caused by COVID 19, a convenience sample of respondents was selected.

Key words: Motor development, TGMD 3, childhood, reliability, confirmatory factor analysis.

* **Corresspondence to:**
Senad Mehmedinović, Faculty of Education and Rehabilitation, University of Tuzla
E-mail: senad.mehmedinovic@gmail.com

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

SAŽETAK

Cilj istraživanja je bio utvrditi metrijske karakteristike testa za procjenu grubih motoričkih sposobnosti (TGMD 3). Istraživanjem je obuhvaćeno 146 djece iz Bosne i Hercegovine, uzrasta od 3-10,4 godina (6,80 ± 2,23 godina; 46,6% dječaci; 53,4% djevojčice). Na osnovu dobijenih rezultata istraživanja može se zaključiti da Test za procjenu grubih motoričkih sposobnosti (TGMD 3) ima zadovoljavajuću pouzdanost i unutrašnju saglasnost. Međusobne korelacije potvrđuju homogenost skale. Na osnovu rezultata Kolmogorov-Smirnovljev testa, Test za procjenu grubih motoričkih sposobnosti nije osjetljiv za ispitanike koji su obuhvaćenim ovim istraživanjem. Rezultati konfirmatorne faktorske analize ovog modela pokazuju djelimiČno slaganje pretpostavljenog modela s podacima (h^2 = 108.17, df = 64, h^2 / df = 1.69, TLI = 0.86, CFI = 0.72, NFI = 0.72., RMSEA = 0.07 CI = 0.04-0.09). Rezultati istraživanja obrađeni su u statističkom paketu SPSS 20 (sa paketom AMOS).
Ograničenje u istraživanju su ispitanici, jer je zbog epidemiološke situacije izazvane COVID-om 19 odabran prigodan uzorak ispitanika.

Ključne riječi: Motorički razvoj, TGMD 3, djetinjstvo, pouzdanost, konfirmatorna faktorska analiza.

INTRODUCTION

Motor development refers to controlled and efficient movement in space. In the literature, it is simply referred to as motor development or psychomotor development, because during its evaluation, and especially the creation of stimulus programs, it is simply impossible not to emphasize the importance of affective and cognitive development, communication and their interdependence. The motor development of a child is a process that is reflected in the gradual improvement of the levels of functioning in the field of stability, locomotion and manipulation. The success of this motor expression through games - contacts, will determine the child's sense of security in society with others, and motivation to move, which are some of the basic prerequisites for successful improvement of motor skills of children of this age. Fundamental motor skills are an integral part of the increasingly complex patterns of movement that a person uses in the further developmental continuum. However, maturation, in itself, does not ensure successful mastery of complex patterns of movement. The development of fundamental motor skills is developed thanks to a number of internal and external factors (biological, sociological, psychological, motivational, cognitive, etc.) during free active play and structured programs (Branta, Haubenstricker & Seefeldt, 1984). Investing in basic motor skills in early childhood is very important because it provides children with the prerequisites and potential for successful participation in sports and leisure activities in adolescence and adulthood, because once adopted, they remain for life (Hardy, King, Farrell, Macniven & Howlett, 2009; Magistro, Bardaglio, & Rabaglietti, 2015). Furthermore, previous studies suggested a relationship between early gross motor and later school aged cognitive development (i.e. processing speed and working memory) (Piek, Dawson, Smith, & Gasson, 2008; Son & Meisels, 2006; Kim, Duran, Cameron, & Grissmer, 2017) and a relationship between reading and locomotor skills, and mathematics and object-control skills

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

in children with learning disorder (Westendorp, Hartman, Houwen, Smith, & Visscher, 2011). The assessment of gross motor developmental status among children can provide valuable information to identify possible motor delays and deficits (Magistro, Piumatti, Carlevaroc, Sherar, Esliger, Bardaglioc, Magnoc, Zecca & Musella, 2020). On the other hand, process-oriented assessment techniques evaluate the presence or absence of movement patterns demonstrated by a child providing qualitative information on children's motor competence that can be used for design and planning interventions (Yun & Shapiro, 2004; Bardid, Vannozzi, Logan, Hardy & Barnett, 2019).The appropriate overtime assessment of proficiency and development of these skills depends on the use of reliable and valid instruments (Netelenbos, 2005; Valentini, 2012). Among process-oriented assessment tools, the Test of Gross Motor Development (TGMD) and its variants Test of Gross Motor Development–Second Edition (TGMD-2) and Test of Gross Motor Development–Third Edition (TGMD-3) are, probably, the most frequently used technique for measuring fundamental motor skills proficiency in educational, clinical, and research settings because of their low cost and feasibility (Klingberg, Schranz, Barnett, Booth, & Ferrar, 2019; Ulrich, 1985; Ulrich, 2000; Urlich, 2016). The TGMD is a normative and criterion-based assessment designed to qualitatively evaluate the gross motor skill performance of children between the ages of 3 to 10 years and 11 months, with and without disabilities (Ulrich, 1985; Ulrich, 2000; Urlich, 2016). The TGMD is composed of two subscales, locomotor and object control/ball skills, which evaluate six to seven fundamental motor skills with between three to five performance criteria, depending on skill (Ulrich, 2000; Urlich, 2016). Child performance is scored with 1 or 0 depending on the presence or absence of such criteria and the final raw scores can be converted into percentile ranks and standard scores. The test results can be used to identify children with gross motor develop mental delay (Brian, Pennell, Taunton, Starrett, Howard-Shaughnessy, Goodway, et al, 2019), to design, plan and evaluate the success of program interventions in FMS development, to assess individual progress, and to serve as an assessment tool in research (Urlich, 2000). In recent years, several studies have been published that examined the inter-rater, intra-rater, and test-retest reliability of the TGMD in different population groups, typically developing children (Wagner, Webster & Urlich, 2017; Magistro, Piumatti, Carlevaroc, Sherar, Esliger, Bardaglioc, Magnoc, Zecca & Musella, 2020) including children with autism spectrum disorder (Allen, Bredero, Van Damme, Ulrich & Simons, 2017), children with attention deficit hyperactivity disorder (Pan, Tsai & Chu, 2009], children with visual impairments (Houwen, Hartman, Jonker & Visscher), children with mental and behavioural disorders [Magistro, Piumatti, Carlevaro, Sherar, Esliger, Bardaglio, et al, 2018], and children with intellectual disabilities (Simons, Daly, Theodorou, Caron Simons & Andoniadou, 2008).

This study aimed to determine metric characteristics of the Test of Gross Motor Development (TGMD 3) on the children aged 3-10.4 years in Bosnia and Herzegovina.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

MATERIAL AND METHODS

Sample of participant

The research included a total sample of 146 examinees, of both sexes. The research included examinees aged 3 to 10.4 years. The average chronological age of the subjects was 6.80 ± 2.23 years, and ranged from 3 to 10.4 years. Out of 146 examinees, 11 (7.5%) examinees were 3 years old, 21 (14.4%) examinee were 4 years old, 23 (15.8%) examinees were 5 years old, 24 (16, 4%) examinees were 6 years old, 16 (11%) examinees were 7 years old, 5 (3.4%) examinees were 8 years old, 30 (20.5) examinees were 9 years old and 16 (11%) examinees were 10 years old. The research was conducted in Bosnia and Herzegovina, in the area of cities of Tuzla, Sarajevo, Mostar and Pale.

Measuring instruments

For the purpose of checking the set aim of the research, there was used the Test of Gross Motor Development (Ulrich, 2016). Gross Motor Development Test (TGMD) is a process-oriented test of gross motor skills of children aged from 3 to 10 years. The Test of Gross Motor Development (TGMD-3), is a valid and reliable tool for assessing 6 locomotor and 7 object-control skills among children aged 3-10 years-old.

Data processing methods

Research data were processed by the methods of parametric and nonparametric statistics. There were calculated basic statistical parameters of the central tendency measure, dispersion measures, frequencies and percentages, and the results are presented in tables and graphs. Cronbach's alpha value was calculated to verify the set objectives of the research, and measures of symmetry and kurtosis were presented to determine the sensitivity of the test and the normality of the data distribution. To examine the normality of the data distribution there was used the Kolmogorov-Smirnov test. In order to determine the factor structure, i.e. validity, of the Test of Gross Motor Development (TGMD-3) there was applied confirmatory factor analysis. The analysis was performed using the maximum probability algorithm. The data was analyzed with the SPSS 20 software (with the AMOS package).

RESULTS AND DISCUSSION

Based on the obtained research results, and in terms of reliability check of the measuring instrument, it can be concluded that Test of Gross Motor Development (TGMD-3) has satisfactory reliability and internal consistency for children aged 3 to 10 years, with Cronbach's alpha value of 0.81 The results of Cronbach’s alpha value are satisfactory and are in compliance with the results of a study by Weber and Ulrich (2017) entitled “Evaluation of the Psychometric Properties of the Test of Gross Motor Development—Third Edition”.
The results of these authors showed that internal consistency was very high in each age group and remained excellent for all racial / ethnic groups and both sexes. Acceptable values of Cronbach's alpha are above 0.7, however, values above 0.8 are preferred (Pallant, 2011).

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

Cronbach's alpha values are acceptable in the Locomotion subtest (α=0.71) and in the Ball Skills subtest (α=0.72). Based on the results of the inter-item correlation matrix, the values obtained between the statements are positive, which shows that they measure the same feature. The results in Table 1 show inter-item statistics and reliability within the measuring instrument. The arithmetic means of the instrument range from 72.62 to 75.62; scale variances range from 176.89 to 209.91; Cronbach's alpha coefficient ranges from 0.80 to 0.82. Mutual correlations of variables and the instrument range from 0.35 to 0.37. According to Pallant's instructions (2011), if the degree of correlation of each variable with the total score is less than 0.30, the result shows that the variable measures something other than what the whole measurement scale measures, which is not the case in this study. Therefore, mutual correlations confirm the homogenity of the scale.

Table 1. Inter-item statistics

Variables	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Run	73,50	205,98	0,35	0,82
Gallop	74,53	188,24	0,49	0,81
Hop	72,62	176,89	0,58	0,80
Skip	75,60	205,55	0,39	0,81
Horizontal Jump	73,44	196,28	0,54	0,80
Slide	73,93	191,80	0,48	0,81
Two-hand strike of a stationary ball	73,75	187,55	0,54	0,80
One-hand forehand strike of self-bounced ball	74,97	194,56	0,41	0,81
One-hand stationary dribble	75,62	181,80	0,57	0,80
Two hand catch	75,03	209,42	0,43	0,81
Kick a stationary ball	73,53	209,91	0,35	0,82
Overhand throw	74,50	193,64	0,41	0,81
Underhand throw	74,14	196,65	0,47	0,81

Table 2 shows the results of descriptive statistics and the Kolmogorov-Smirnov test, which is the base for estimating the sensitivity of the measuring instrument. The obtained results show that the distribution of data is negatively asymmetric, leptokurtic and platykurtic. The results of the Kolmogorov-Smirnov test show that there is a statistically significant difference between the obtained and theoretically normal distribution of results. Based on the results of the KS test, it can be concluded that Test of Gross Motor Development (TGMD-3) is not sensitive for subjects included in this study.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

Table 2. Descriptive statistics and Kolmogorov-Smirnov test (KS)

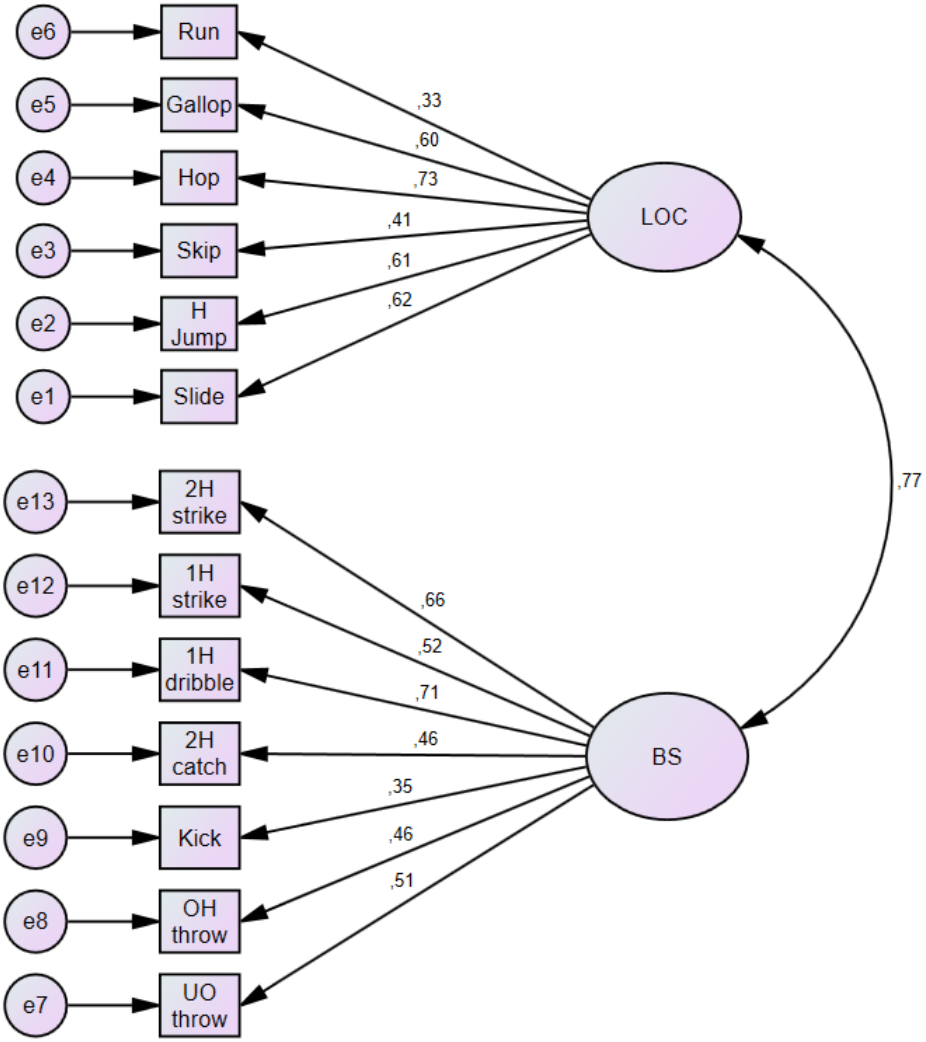
Variables	AS	SD	Min	Max	Skew	Kurt	KS	p
Run	6,93	1,68	0,00	8,00	-1,66	2,48	0,37	,000
Gallop	5,90	2,38	0,00	8,00	-1,07	0,20	0,20	,000
Hop	7,81	2,70	0,00	10,00	-1,23	0,73	0,22	,000
Skip	4,83	1,59	0,00	6,00	-1,44	1,49	0,30	,000
Horizontal Jump	6,99	1,76	0,00	8,00	-2,09	4,19	0,35	,000
Slide	6,50	2,20	0,00	8,00	-1,47	1,21	0,31	,000
Two-hand strike of a stationary ball	6,68	2,24	1,00	10,00	-0,26	-0,69	0,17	,000
One-hand forehand strike of self-bounced ball	5,47	2,28	0,00	9,00	-0,72	-0,17	0,13	,000
One-hand stationary dribble	4,82	2,45	0,00	8,00	-0,34	-0,90	0,14	,000
Two hand catch	5,40	1,20	0,00	6,00	-2,53	6,92	0,40	,000
Kick a stationary ball	6,90	1,38	4,00	8,00	-0,89	-0,55	0,32	,000
Overhand throw	5,93	2,32	0,00	10,00	-0,74	-0,62	0,24	,000
Underhand throw	6,29	1,92	0,00	9,00	-0,96	0,29	0,23	,000

In order to determine the factor structure, i.e. validity, of the Test of Gross Motor Development (TGMD-3) there was applied confirmatory factor analysis (Graph. 1).

The analysis was performed using the maximum probability algorithm. Applying Hopkins (2002) criteria, as stated by Ulrich (2016), the sizes of the Factor loadings in Graph 1 range from moderate and large to very large for two variables. The correlation between the subtest "Locomotion" and "Ball Skills" is 0.77 and is very high, according to the Hopkins criteria (2002).The chi-square test, the ratio of the chi-square to the number of degrees of freedom, CFI (Comparative Fit Index, Bentler's 1990), NFI (Bentler and Bonett's normed fit index, 1980), TLI (Tucker-Lewis Index, 1973) and RMSEA (Root Mean Square Error Approximation, Browne and Cudeck's, 1993) were calculated as indicators of agreement of the model with the data.The criterion for an acceptable fit varies among different types of indexes (Ulrich, 2016). Marsh and Hocevar (1985) cited by Ulrich (2016) suggested that relative chi-square values can be as low as 2 or as high as 5 to indicate a reasonable fit.

The TLI, CFI, and NFI values should be at or above .90 to indicate a satisfactory model fit, which values close to 1 indicating a very good fit on any of these indexes (Ulrich, 2016). An RMSEA of less than .11 indicates a reasonable fit, and an RMSEA of .05 or less indicates a close fit of the model in relation to the degrees of freedom (Browne, Cudeck, 1993 cited by Ulrich, 2016). The obtained results of the confirmatory factor analysis of this model show a partial agreement of the assumed model with the data (h^2 = 108.17, df = 64, h^2 / df = 1.69, TLI = 0.86, CFI = 0.72, NFI = 0.72., RMSEA = 0.07 CI = 0.04-0.09). RMSEA values are less than .11 and indicate a reasonable fit of the model in relation to the degrees of freedom. The ratio of the chi square of the test to the number of degrees of freedom is less than 2 and indicates a reasonable fit as well. The results of the incremental stacking indices are at the limit and are 0.86 (TLI) and 0.89 (CFI), while the NFI value is 0.72 and is significantly below the acceptable limit of 0.90.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146



Graph 1. Confirmatory factor analysis

CONCLUSION

Based on the obtained research results it can be concluded that Test of Gross Motor Development (TGMD-3) has satisfactory reliability and internal consistency for children aged 3 to 10 years. Based on the of the inter-item correlation matrix, the values obtained between the statements are positive, which shows that they measure the same feature and mutual correlations confirm the homogenity of the scale. Based on results it can be concluded that Test of Gross Motor Development (TGMD-3) is not sensitive for subjects included in this study. The obtained results of the confirmatory factor analysis of this model show a partial agreement of the assumed model with the data. The limitations in the research are the respondents, because due to the epidemiological situation caused by COVID 19, a convenience sample of respondents was selected.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

ACKNOWLEDGEMENTS

This study was supported in part by a grant from the B&H Federal Ministry of Education and Science, (Grant Award No. 01-6260-1-IV/20). The opinions expressed do not necessarily reflect the position or policy of the B&H Federal Ministry of Education and Science.

LITERATURE

1. 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: 813–33. https://doi.org/10.1007/s10803-016-3005-0 PMID: 28091840
2. Bardid, F., Vannozzi, G., Logan, S.W., Hardy, L.L., & Barnett, L.M. (2019). A hitchhiker's guide to assessing young people's motor competence: Deciding what method to use, Journal of Science and Medicine in Sport, 22: 311–8. https://doi. org/10.1016/j.jsams.2018.08.007 PMID: 30166086.
3. Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238.
4. Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness-of-fit in the analysis of covariance structures.Psychological Bulletin, 88, 588–600.
5. Branta, C., Haubenstricker, J., & Seefeldt, V. (1984). Age changes in motor skills during childhood and adolescence, Exercise & Sport Sciences Reviews,12: 467–520.
6. Brian, A., Pennell, A., Taunton, S., Starrett, A., Howard-Shaughnessy, C., Goodway, J.D., et al. (2019). Motor Competence Levels and Developmental Delay in Early Childhood: A Multicenter Cross-Sectional Study Conducted in the USA, Sport Medicine, 49: 1609–18.
7. Browne, M. W., & Cudeck, R. (1993). *Alternative ways of assessing model fit*. In K. A. Bollen and J. S. Long (Eds.), Testing structural equation models (pp. 136-162). Newbury Park, CA: Sage.
8. Magistroa, D., Piumatti, G., Carlevaroc, F., Sherar, L.B., Esliger, D.W., Bardaglioc, G., Magnoc, F., Zecca, M., & Musellac, G. (2020) Psychometric proprieties of the Test of Gross Motor Development–Third Edition in a large sample of Italian children, Journal of Science and Medicine in Sport, https://doi.org/10.1016/j.jsams.2020.02.014
9. Hardy, L.L., King, L., Farrell L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children, Journal of Science and Medicine in Sport, 13(5): 503-8. doi: 10.1016/j.jsams.2009.05.010. Epub 2009 Oct 22.
10. Hopkins,W.G. (2002). *A scale of magnitudes for the effecet statistics*. In a new view of statistics. Retrieved December 05, 2021, from http://www.sportsci.org/resource/stats/effectmag.html
11. Houwen, S., Hartman, E., Jonker, L., & Visscher, C. (2010). Reliability and Validity of the TGMD-2 in Primary-School Age Children With Visual Impairments. Adapted Physical Activity Quarterly, 27: 143–59.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

12. Kim, H., Duran, C. A. K., Cameron, C. E., & Grissmer, D. (2017). Developmental Relations Among Motor and Cognitive Processes and Mathematics Skills, Child Development, n/a-n/a. https://doi.org/10.1111/cdev.12752
13. Klingberg, B., Schranz, N., Barnett, L.M., Booth, V., & Ferrar, K. (2019). The feasibility of fundamental movement skill assessments for pre-school aged children, Journal of Sports Science, 37: 378–86. https://doi.org/10.1080/ 02640414.2018.1504603 PMID: 30084306
14. Magistro, D., Piumatti, G., Carlevaro, F., Sherar, L.B., Esliger, D.W., Bardaglio, G., et al. (2018). Measurement invariance of TGMD-3 in children with and without mental and behavioral disorders, Psychological Assessment, 30: 1421–9. https://doi.org/10.1037/pas0000587 PMID: 29792504
15. Magistro, D., Bardaglio, G., & Rabaglietti, E. (2015). Gross Motor Skills and Academic Achievement in Typically Developing Children: The Mediating Effect of Adhd Related Behaviours, Cognition, Brain, Behavior an Interdisciplinary Journal, 19 (2).
16. Marsh, H. W., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of self-concept: First- and higher order factor models and their invariance across groups. *Psychological Bulletin*, 97(3), 562–582. https://doi.org/10.1037/0033-2909.97.3.562.
17. Netelenbos, J.B. (2005).Teachers' ratings of gross motor skills suffer from low concurrent validity. Human Movement Science, 24(1):116–137.
18. Pallant, J. (2011). SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS, Fourth Edition. Allan & Unwin.
19. Pan, C.Y., Tsai, C.L., & Chu, C.H. (2009) Fundamental Movement Skills in Children Diagnosed with Autism Spectrum Disorders and Attention Deficit Hyperactivity Disorder, Journal of Autism and Developmental Disorder, 39: 1694–705. https://doi.org/10.1007/s10803-009-0813-5 PMID: 19588236.
20. Piek, J. P., Dawson, L., Smith, L. M., & Gasson, N. (2008). The role of early fine and gross motor development on later motor and cognitive ability, Human Movement Science, 27(5), 668–681.
21. Simons, J., Daly, D., Theodorou, F., Caron, C., Simons, J., & Andoniadou, E. (2008). Validity and Reliability of the TGMD-2 in 7–10-Year-Old Flemish Children with Intellectual Disability, Adapted Physical Activity Quarterly, 25: 71–82.
22. Son, S.H., & Meisels, S.J. (2006). The relationship of young children's motor skills to later reading and math achievement, Merrill-Palmer Quarterly (1982-), 755–778.
23. Tucker, L., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, 38, 1–10. https://doi.org/10.1007/BF02291170 - DOI.
24. Ulrich, D. (1985). Test of Gross Motor Development, Austin, TX: Pro-Ed.
25. Ulrich, D.A. (2000). Test of Gross Motor Development (2nd ed.). Austin, TX: Pro-Ed.
26. Ulrich D.A. (2016). Test of Gross Motor Development (3rd ed.), Austin, TX: Pro-Ed.
27. Valentini, N.C. (2012). Validity and reliability of the TGMD-2 for Brazilian children, Journal of Motor Behavior, 44(4):275–280.

Research in Education and Rehabilitation 2021; 4(2): 146-155. DOI 10.51558/2744-1555.2021.4.2.146

28. Webster, E.P., Ulrich. D.A. (2017). Evaluation of the PsychometricProperties of the Test of Gross Motor Development—Third Edition. Journal of Motor Learning and Development, 5, 45 -58. https://doi.org/10.1123/jmld.2016-0003
29. Westendorp, M., Hartman, E., Houwen, S., Smith, J., & Visscher, C. (2011). The relationship between gross motor skills and academic achievement in children with learning disabilities, Research in Developmental Disabilities, 32(6), 2773–2779. https://doi.org/10.1016/j.ridd.2011.05.032
30. Yun, J., & Shapiro, D.R. (2004). A Quantitative Approach to Movement Skill Assessment for Children with Mental Retardation, Adapted Physical Activity Quarterly, 21: 269–80.