Acta Orthopaedica et Traumatologica Turcica xxx (xxxx) xxx

Contents lists available at ScienceDirect

Acta Orthopaedica et Traumatologica Turcica

journal homepage: https://www.elsevier.com/locate/aott

Inter–intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy

Cemil Ozal*, Gonca Ari, Mintaze Kerem Gunel

Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Ankara, Turkey

ARTICLE INFO

Article history:
Received 31 January 2018
Received in revised form
19 February 2019
Accepted 28 April 2019
Available online xxx

Keywords:
Cerebral palsy
Trunk
Trunk control
Postural control
Trunk measurement

ABSTRACT

Objective: The aim of this study was to demonstrate the inter and intra rater reliability and validity of the Turkish version of the Trunk Control Measurement Scale (TCMS) for children with CP.
Methods: Fifty children (21 girls and 29 boys; mean age 6.6 ± 2.3 years) with spastic, dyskinetic and ataxic types of CP were participated in the study. Children with Level I–II and III according to Gross Motor Function Classification System (GMFCS) were included into the study. All children were evaluated separately by two physiotherapists for interrater reliability and they re-evaluated for intra rater reliability. Gross Motor Function Measurement total score and B part were used for construct validity.
Results: The intraclass correlation coefficient (ICC) value of the inter-rater reliability for the Turkish TCMS was 95% CI (0.823–886), and the intra-rater reliability was 95% CI (0.986–0.992). The Spearman rank correlation coefficient between the Turkish TCMS and the Gross Motor Function Measure total score r: 0.827; $p < 0.05$ Part B was r: 0.863; $p < 0.05$.
Conclusion: The results of the study support that the Turkish TCMS has a high inter and intra rater reliability and validity similar to the original version. Thus, the Turkish TCMS appears to be a suitable evaluation tool to assess the qualitative performance of trunk control and sitting balance for children with CP and it gives opportunity to use clinically and research purposes.
Level of Evidence: Level III, Diagnostic Study.

Introduction

Cerebral palsy (CP) is a neurodevelopmental condition caused by a non-progressive brain lesion that occurs before, during, or shortly after birth, and although the lesion is not progressive, with muscle tone, posture and movement deficiencies, severity of disability and impact on function may be progressive.[1] Children with CP usually have weak postural control.[2] Postural control can be defined as control of the body to provide stabilization and orientation and it is essential for all movement components.[3] As a part of postural control, trunk control means control of trunk which includes stability and selective movements of trunk.[4] This stabilization is basis for dissociated and selective movements of limbs and head. Postural problems including trunk control, have a central role on motor disfunction of children with CP.[5–7] According to several studies, children with CP have trunk control impairment and it affects sitting and standing skills as well as performing functional activities such as reaching and walking.[8] Additionally, trunk control is necessary for keeping body position, maintaining stabilization while changing positions and doing daily life activities. Also, it gives opportunity to obtain erect posture, arrange weight shifting, move against gravity in a controlled manner, control body position for balance and function and during position changes. Studies on postural control have shown association between level of trunk control and sitting balance and extremity functions.[9] Basic trunk movements are essential for maintaining mobility and postural adjustments during limb movements.[10–14]

It is important to use standardized measurement tools to better understand any impairment in trunk control; however, clinical tools that evaluate trunk control of CP are limited.[15] Although there are some Turkish scales for the assessment of gross motor, function and balance; there is no scale that evaluates trunk control directly. The "Trunk Control Measurement Scale (TCMS)" was developed by

Abbreviations: CP, Cerebral Palsy; TCMS, Trunk Control Measurement Scale; GMFM, Gross Motor Function Measurement; GMFCS, Gross Motor Function Classification System.

* Corresponding author. Hacettepe Üniversitesi, Fizik Tedavi ve Rehabilitasyon Fakültesi, 06100 Samanpazarı, Ankara, Turkey.
E-mail address: cemilozal@hotmail.com (C. Ozal).

Peer review under responsibility of Turkish Association of Orthopaedics and Traumatology.

https://doi.org/10.1016/j.aott.2019.04.013

Please cite this article as: Ozal C et al., Inter–intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy, Acta Orthop Traumatol Turc, https://doi.org/10.1016/j.aott.2019.04.013

Heyrman and et al in 2011 in order to determine inefficiency of trunk control in children with CP and clinical features related with it; based on the "Trunk Impairment Scale – TIS" which evaluate adults with stroke. TCMS scores the quality of trunk control and compensations of trunk.[16]

In this study, TCMS was translated into Turkish with preserving its English originality and based on the instructions of World Health Organization necessary adaptations were made so that the scale fits properly with Turkish culture and life style. The aim of this study was to prepare the Turkish version of the original TCMS and evaluate the reliability and validity of the Turkish version.

Material and method

Participants

50 children with CP, mean age 6,6 ± 2,3 years (21 girls and 29 boys) who referred to XXX University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation were included in the study. Inclusion criteria was sitting without support, not having communication limitation and not having any orthopedical surgery or botulinum toxin injection during the last 6 months. Prior to the initiation of the study, the aims of the study were explained and ethical approval was obtained from ethical committee of Hacettepe University Non- Interventional Clinical Researches Ethics Board (No: GO 17/752-34). All children were classified according to Gross Motor Function Classification System (GMFCS). The features of the participants are shown in Table 1.

Measurements

Trunk Control Measurement Scale

TCMS measures the trunk control in two basic components that are static and dynamic sitting balance. Dynamic sitting balance is divided in two parts as selective movement control and dynamic reaching. Static sitting balance part evaluates trunk control during upper and lower limbs' movements in sitting position. Balance is assessed during flexion, extension, lateral flexion and rotation movements as selective movements of dynamic sitting. Reaching part of dynamic sitting balance evaluates trunk balance during reaching at different planes. The scale is consisted of 15 items. Each part has 5,7 and 3 items respectively. Total score ranges between 0 and 58 and higher scores reflect better control. Interclass correlation coefficient (ICC) of validity of the scale inter rater is 0,98; ICC for pretest–posttest is 0,97 and Spearman correlation rate between TCMS and GMFM (except for part A) for construct validity for construct validity is between 0,6–0,87. These values show that TCMS is a valid and reliable measurement tool.[8,16]

Table 1
The features of participants.

Age (n ± SD)	6,6 ± 2,3
Gender	n (%)
Girl	21 (42)
Boy	29 (58)
Type of CP	n (%)
Spastic	40 (80)
Quadriplegia	10 (20)
Diplegia	20 (40)
Hemiplegia	10 (20)
Dyskinetic	
Chorea–athetosis	10 (20)
GMFCS	
Level I	11 (22)
Level II	24 (48)
Level III	15 (30)

Gross Motor Function Measurement (GMFM)

Gross motor abilities were evaluated by GMFM-88. GMFM shows changes in motor development and measure the amount of motor performance achieved. GMFM is the most common used measurement in children with CP for evaluating motor development and it is valid, reliable and useful.[17] All motor skills in GMFM can be completed by a child at 5 years of age. It is consisted of 88 items that are categorized in 5 parts: Part (A): lying–rolling (17 items), Part (B): sitting (20 items), Part(C): crawling–kneeling (14 items), Part (D): standing, Part (E): walking–running–jumping (24 items). These items are scored according to accomplishment level with 4 points Likert scale.[18]

Translation process

Based on the instructions by World Health Organization, the translation process of TCMS consisted of two parts. After necessary approval was obtained from the developers, the scale was translated into Turkish by two native Turkish speaker physiotherapists who have medical/clinical background. Then both translated documents were combined as draft translation. The translated scale was back translated into English by a translator and compared with original scale to correct translation mistakes. A linguist supported in necessary areas.

Procedure

Inter and intra-rater reliability

All participants were evaluated by two physiotherapists; and two weeks later, the same physiotherapists re-evaluated the participants.

Construct validity

The Spearman correlation was investigated between total score of GMFM Part B and the Turkish TCMS that was applied by the physiotherapists.

Statistical analysis

All data were analyzed using SPSS for Windows software program. Inter-rater and intra-rater reliability for the Turkish TCMS score was presented by ICC and the 95% confidence intervals (CI). For intra-rater reliability, the ICC value was used. Values of 0.41–0.60 indicate moderate agreement, 0.61 to 0.80 substantial agreement, and 0.81 to 1.00 almost perfect agreement.[25] To investigate construct validity, Turkish TCMS was compared with GMFM-Part B and total score by Spearman rank correlation coefficient.

Results

Inter and intra-rater reliability

The ICC values for intra-rater reliability were 0.986–0.992 and for inter-rater reliability was 0.823–886. 95% CI of the total T-TCMS values were 0.992–0.998 for intra-rater reliability and 0.976–991 for inter-rater reliability. ICC and 95% CI of the subtests and total Turkish TCMS values are presented in Table 2.

Table 2
Inter and intra rater reliability for the Turkish TCMS (n = 50).

	Inter-rater reliability		Intra-rater reliability	
	ICC	95% CI	ICC	95% CI
Static sitting balance	0,873	0965–0,980	0964	0,982–0994
Selective movement control	0,854	0974–0,983	0926	0,965–0986
Dynamic reaching	0,846	0962–0,978	0932	0,914–0947
Total score	0,886	0976–0,991	0988	0,992–0998

Please cite this article as: Ozal C et al., Inter–intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy, Acta Orthop Traumatol Turc, https://doi.org/10.1016/j.aott.2019.04.013

Construct validity

The Spearmen Correlation Coefficient between the Turkish TCMS and total GMFM was r: 0,827; $p < 0,05$; T-TCMS and GMFM-B was r: 0,861; $p < 0,05$ and positively significant.

Discussion

This study aimed to evaluate inter and intra-rater reliability and construct validity of the Turkish TCMS. As a result of this study, the Turkish version of a new measurement for evaluating trunk control abilities and sitting balance of children with CP was added to the literature. Determining measure's validity and reliability in targeted group is important beside its translation process. GMFM-88 was used for assessing the construct validity of the Turkish TCMS. Trunk control underlies in gross motor activities such as rolling, sitting, walking or jumping, all of which can be measured using GMFM. Although GMFM has two different forms −88 and 66 items − Russell et al reported that GMFM-66 is inefficient in describing functionality in lower level activities such as rolling or sitting.[19] In the current study, GMFM-88 was preferred since it is reported to be more related with trunk control. Additionally, GMFM-88 was used in several previous studies. In their study, Curtis et al (2015)[20] reported a direct significant relationship between The Segmental Assessment of Trunk Control (SATCo) and part B of GMFM.

Heyrman et al,[16] have shown a positively significant relationship between TCMS and GMFM-Part E, which evaluates advanced functionality like walking and jumping. These findings support that trunk control becomes more important in advanced level motor activities in children with CP. Out of this point, total score of GMFM-88 was utilized in this study.

In evaluating motor function, regulating clinical practice protocols or determining therapy approaches and aims in children with CP, valid and reliable assessment tools as GMFCS and GMFM are being used and translated to different languages.[21] However, these assessment tools are not effective in evaluating the ability of the patient in performing various stages of any movement, since they focus on the overall result of the performance rather than the quality of movement. TCMS is valuable since it takes into account both the quality of movement and the result of performance.[15]

In literature, there are several scales evaluating trunk control of children with CP, which are developed by different researchers. Out of these scales, Seated Postural Control (SPCM) has low reliability, since it does not assess the dynamic and static components of trunk control.[22] SATCo, another scale for evaluating trunk control, includes only static sitting balance, so it is impossible to assess dynamic trunk control with this scale.[23] Hence, both these scales are insufficient in measuring both static and dynamic aspects of trunk control in functional movements.

The Trunk Impairment Scale (TIS), which was developed to evaluate trunk control of stroke patients, measures trunk control in static, dynamic and coordination parts. Although several studies have used TIS for children with CP, it is a difficult scale to be use in this population.[24] TCMS originated from TIS and measures both the dynamic and static features of trunk control in children with CP.

According to the International Classification of Functioning, Disability and Health (ICF) the TCMS is a Body Function measure, and impairment in trunk control, may influence activity and participation limitations affected by mobility. Additionally, poor trunk control affects stability of the head in space thus affecting visual skills, eye-hand coordination, upper limb functions, and may cause restrictions on major life areas such as educational settings and social interaction of children with CP.[23]

Although compensatory strategies like hand support can be of value in daily functioning, the TCMS seeks to define the true level of trunk control.

Among current reliability studies, which are mostly based on elder children with CP, this study includes a younger population of CP children less than 7 years of age. This difference may be important since it reflects the efficiency and reliability of TCMS in younger group of patients. In clinical and research settings, this scale can be used in such younger groups of children with CP.

Conclusion

The reliability and validity of the original version of the scale were already investigated; but utilization of languages other than English is limited. According to the results of this study, TCMS is a valid and reliable scale that can be used both clinically and for research purposes. Furthermore, it can help to compare data in different cultures and it may increase the efficiency of intervention studies in future.

Conflict of interest

Authors declare that no conflict of interest.

References

1. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M. A report: the definition and classification of cerebral palsy. *Dev Med Child Neurol*. 2007;49:8−14.
2. Bourelle S, Berge B, Gautheron V, et al. Computerized static posturographic assessment after treatment of equinus deformity in children with cerebral palsy. *J Pediatr Orthop B*. 2010;19:211−220.
3. Shumway-Cook, Woollacott MH. *Motor Control: Translating Research into Clinical Practise*. Pennsylvania: Lippincott Williams & Wilkins; 2007.
4. Gjelsvik BEB. *The Bobath Concept in Adult Neurology*. 1st ed. Stuttgart: Georg Thieme Vorlag; 2008.
5. Sæther R. *Trunk Control in Children with Cerebral Palsy: A Reliability Study of the Trunk Impairment Scale*. Tromsø: Universiteteti Tromsø; 2010 (Thesis).
6. Bertenthal B, VonHofsten C. Eye, head and trunk control: the foundation for manual development. *Neurosci Biobehav Rev*. 1998;22:515−520.
7. Graaf-Peters VB, Blauw-Hospers CH, Dirks T, et al. Development of postural control in typically developing children and children with cerebral palsy: possibilities for intervention? *Neurosci Biobehav Rev*. 2007;31:1191−1200.
8. Heyrman L, Desloovere K, Molenaers G, et al. Clinical characteristics of impaired trunk control in children with spastic cerebral palsy. *Res Dev Disabil*. 2013;34:327−334.
9. Kavanagh J, Barrett R, Morrison S. The role of the neck and trunk in facilitating head stability during walking. *Exp Brain Res*. 2006;172:454−463.
10. Ledebt A, Bril B. Acquisition of upper body stability during walking in toddlers. *Dev Psychobiol*. 2000;36:311−324.
11. Patla AE, Adkin A, Ballard T. Online steering: coordination and control of body center of mass, head and body reorientation. *Exp Brain Res*. 1999;129:629−634.
12. Saavedra S, Joshi A, Woollacott M, et al. Eye hand coordination in children with cerebral palsy. *Exp Brain Res*. 2009;192:155−165.
13. Schmid M, DeNunzio AM, Schieppati M. Trunk muscle proprioceptive input assists steering of locomotion. *Neurosci Lett*. 2005;384:127−132.
14. Van deWalle P, Hallemans A, Truijen S, et al. Increased mechanical cost of walking in children with diplegia: the role of the passenger unit cannot be neglected. *Res Dev Disabil*. 2012;33:1996−2003.
15. Jeon JY, Shin WS. Reliability and validity of the Korean version of the Trunk Control Measurement Scale (TCMS-K) for children with cerebral palsy. *Res Dev Disabil*. 2014;35:581−590.
16. Heyrman L, Molenaers G, Desloovere K, et al. A clinical tool to measure trunk control in children with cerebral palsy: the trunk control measurement scale. *Res Dev Disabil*. 2011;32:2624−2635.
17. Palisano RJ, Hanna SE, Rosenbaum PL, et al. Validation of a model of gross motor function for children with cerebral palsy. *Phys Ther*. 2000;80:974−985.
18. Russell DJ, Rosenbaum PL, Cadman DT, Gowland C, Hardy S, Jarvis S. The gross motor function measure: a means to evaluate the effects of physical therapy. *Dev Med Child Neurol*. 1989;31:341−352.
19. Russell DJ, Avery LM, Rosenbaum PL, Raina PS, Walter SD, Palisano RJ. Improved scaling of the gross motor function measure for children with cerebral palsy: evidence of reliability and validity. *Phys Ther*. 2000;80:873−885.
20. Curtis DJ, Butler P, Saavedras S, et al. The central role of trunk control in the gross motor function of children with cerebral palsy: a retrospective cross-sectional study. *Dev Med Child Neurol*. 2015;57:351−357.
21. Palisano RJ, Cameron D, Rosenbaum PL, Walter SD, Russell D. Stability of the gross motor function classification system. *Dev Med Child Neurol*. 2006;48:424−428.

Please cite this article as: Ozal C et al., Inter−intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy, Acta Orthop Traumatol Turc, https://doi.org/10.1016/j.aott.2019.04.013

22. Fife SE, Roxborough LA, Armstrong RW, Harris SR, Gregson JL, Field D. Development of a clinical measure of postural control for assessment of adaptive seating in children with neuromotor disabilities. *Phys Ther*. 1991;71:981–993.
23. Butler PB, Saavedra S, Sofranac M, Jarvis SE, Woollacott MH. Refinement, reliability, and validity of the segmental assessment of trunk control. *Pediatr Phys Ther*. 2010;22:246–257.
24. Verheyden G, Nieuwboer A, Mertin J, Preger R, Kiekens C, De Weerdt W. The Trunk Impairment Scale: a new tool to measure motor impairment of the trunk after stroke. *Clin Rehabil*. 2004;18:326–334.
25. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med*. 2012;22:276–282.

Please cite this article as: Ozal C et al., Inter–intra observer reliability and validity of the Turkish version of Trunk Control Measurement Scale in children with cerebral palsy, Acta Orthop Traumatol Turc, https://doi.org/10.1016/j.aott.2019.04.013