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ORIGINAL ARTICLE

Validity and Clinical Utility of Functional Assessments in Children With Cerebral Palsy

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Abstract

Objective: To examine the validity and clinical utility of functional assessments (1-minute walk test, 10-meter walk test, Timed Up & Go [TUG] test, Timed Up and Down Stairs [TUDS] test, sit-to-stand [STS] test, and lateral step-up [LSU] test).

Design: Cross-sectional study.

Setting: Four special schools for adolescents with physical disabilities.

Participants: Adolescents with spastic tetraplegia and diplegia (at levels I–III) were selected through convenience sampling (N = 35; mean age, 14.97±2.03y).

Interventions: Not applicable.

Main Outcome Measures: GMFM-88 (dimensions D and E), 1-minute walk, 10-meter walk, TUG, TUDS, STS, and LSU tests. Data were analyzed using Pearson intercorrelations, multiple regression analysis, and multivariate analysis of variance (MANOVA).

Results: Significant moderate to high intercorrelations were found. Three significant positive predictors emerged (1-minute walk, 10-meter walk, and LSU) with the following regression equation: $Y_{\text{GMFM-88 (dimensions D and E)}} = 5.708 + .402 \times X_{\text{1-minute walk}} + .920 \times X_{\text{LSU}} + .404 \times X_{\text{10-meter walk}}$ The MANOVA was significant ($\Lambda = .163$, $F = 14.732$, $P < .001$, $\eta^2 = .596$), and post hoc comparisons revealed significant differences across Gross Motor Function Classification System Expanded and Revised levels in all paired comparisons for the 1-minute walk and LSU tests. For the 10-meter walk test, significant differences were evident in the level I versus level III and level II versus level III comparisons. No significant differences were found in the 10-meter walk test between levels I and II.

Conclusions: These functional assessments (1-minute walk, LSU, and 10-meter walk tests) are simple to administer, quick, low cost, and user-friendly. Although these assessments are not a substitute for the criterion standard (GMFM-88), they may be used for a quick assessment in adolescents with cerebral palsy (levels I–III) either at school or during rehabilitation, especially when time is limited.

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Children with cerebral palsy (CP) experience a range of restrictions with respect to functioning, both in society and personally.[1] These restrictions are commonly assessed with the Gross Motor Function Measure-88 (GMFM-88),[2] which is perceived as the criterion standard.[2-5] The administration of the 88 items and 5 dimensions of the GMFM-88 requires approximately 60 minutes and depends on several factors (eg, ability, understanding, and cooperation of the participants; training and skills of the assessors).[3,6] The Gross Motor Function Measure-66 (GMFM-66)[7] was introduced a few years later as a quicker tool with 66 items to assess the functional mobility of individuals with CP. The GMFM-66 was extracted through Rasch analysis to eliminate certain items and improve the sensitivity and interpretability of the test.[7] One of the criticisms of the GMFM-66 was that it still exhibited a ceiling effect in high level mobility children with CP who were ≥5 years old.[8-10] Nevertheless, both the GMFM-88 and GMFM-66 have been used in several studies so far[8,11,12]; however, Wilson et al[13] claimed that other measures of high level mobility that are valid, reliable, and easily administered in the clinical setting are required.

Recently, a tendency has appeared among researchers to use the D and E dimensions of either the GMFM-88[9,14-17] or the

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GMFM-66[18]; fewer researchers have used the whole measure.[19,20] The decision to use dimensions D and E was based on the specific difficulties experienced in the functioning of children and adolescents with CP who were classified at Gross Motor Function Classification System levels I to III.[14-16] Although the duration of administration of the 37 items of the D and E dimensions has not been reported by the previously mentioned researchers, empirical evidence suggests that it requires approximately 25 to 30 minutes to administer.

Researchers have also introduced several functional assessments that may be used for rehabilitation purposes[21] within the school environment.[22] These measures have exhibited moderate to high intercorrelations with the GMFM-88 and incorporate the 1-minute walk,[23] self-selected walking speed,[24] Time Up & Go (TUG),[3] Timed Up and Down Stairs (TUDS),[25] sit-to-stand (STS),[26] and lateral step-up (LSU) tests.[22,27] Their psychometric properties were supported through the examination of concurrent, construct, convergent validity, and intrarater and interater reliability evidence.[23-28] Further, these measures are simple,[28] cost-effective,[23] and quick[25]; they require 1 (1-minute walk) to 2 (TUDS, TUG) minutes to administer. They assess, according to the *International Classification of Functioning, Disability and Health*, "mobility elements used by individuals to change body position or location, or by transferring from one place to another and by various forms of transportation."[1(p142)]

Within the rehabilitation and school environment, the time available for functional assessment is often limited to 45 to 60 minutes for each session.[16,18,20,29] Time restrictions[23] are usually of concern for physical therapists and practitioners who often need to decide which of the validated measures[30] are efficient in order to adopt or retain a therapeutic action. Therapists may also have limited access to clinically useful tools to measure high level functioning individuals with CP. These tools may be easy to administer and reflect high level mobility goals. To that extent, Marchionni et al[31] stated that the clinical utility of the measures used may lead practitioners to make adequate decisions with regard to the therapy followed. Based on the presented information, the present study examined the validity and clinical utility of functional assessments of adolescents with CP (Gross Motor Function Classification System Expanded and Revised [GMFCS E&R] levels I–III) within the school environment. The criterion-related validity of the functional assessments was examined through association with the GMFM-88 (dimensions D and E) scores. The clinical utility was examined through the prediction of the GMFM-88 (dimensions D and E) and the differences among the 3 classification levels (GMFCS E&R levels I–III) with respect to the emerging significant GMFM-88 (dimensions D and E) predictors. It was anticipated that the significant predictors would differentiate the adolescents with CP according to their classification levels.

List of abbreviations:

CP	**cerebral palsy**
GMFCS E&R	**Gross Motor Function Classification System Expanded and Revised**
GMFM-66	**Gross Motor Function Measure-66**
GMFM-88	**Gross Motor Function Measure-88**
LSU	**lateral step-up**
MANOVA	**multivariate analysis of variance**
STS	**sit-to-stand**
TUDS	**Timed Up and Down Stairs**
TUG	**Timed Up & Go**

Methods

Participants

A convenience sampling method was used. Specifically, 35 adolescents (range, 2–18y) with tetraplegia or diplegia were selected from 4 schools for students with physical disabilities in Athens, Greece. The participants were able to walk with or without aids (GMFCS E&R levels I–III) and to follow simple commands.[22,26] The GMFCS E&R has been recently introduced[32] for individuals with CP who are ≤18 years old, taking into consideration the *International Classification of Functioning, Disability and Health* guidelines and emphasizing the performance in different settings (eg, school and community).[1] Level I represents highly functional performance (eg, walking without limitations), whereas level III represents lower functionality and often requires assistive devices for walking.[32]

Exclusion criteria were as follows: (1) surgery or botulinum toxin injections in the previous 6 months, (2) cardiovascular disease, and (3) uncontrolled epilepsy.[26] The University of Athens and the Pedagogical Institute provided proper permissions according to the ethical standards of the Helsinki Declaration. Informed consent was obtained from both the participants and their parents.

Measures

The whole GMFM-88 incorporates 5 dimensions, which are developed with progressive difficulty. The dimensions include the following: lying and rolling (A: 17 items); sitting (B: 20 items); crawling and kneeling (C: 14 items); standing (D: 13 items); and walking, running, and jumping (E: 24 items). Validity and reliability of the GMFM-88 have been reported in the literature.[2,4,5] In the present study, the average score from dimensions D (ability to achieve and maintain standing, perform activities from standing position) and E (ability to perform walking, jumping activities, climbing stairs, and kick a ball) were used because they are applicable to participants who walk independently with or without aids.[17]

The TUG test was used to assess functional mobility and static and dynamic balance. From a starting position with the hips, knees, and ankles flexed at 90°, the participants had to rise from a chair, with no armrests, walk 3m, return, and sit back in the chair. They were instructed not to run. Time was recorded from the "go" cue provided by the examiner and stopped when buttocks touched the seat.[28] The participants performed the test with shoes and used their walkers or crutches when needed.[28] The TUG is a valid and reliable instrument for the assessment of functional mobility for children with CP.[3,28]

For the TUDS test, participants climbed a staircase with 4 steps (of height 12cm and with lateral handrails), stopped, and returned to the bottom of the staircase.[6] They were instructed to use the handrails when needed,[15,25] but they were not allowed to run. The time was recorded from the command "go" and stopped when both feet were returned to the bottom of the staircase. The test has shown high test-retest reliability and concurrent validity with functional mobility measures for children with CP.[25]

The LSU test evaluates the participant's ability to perform as many repetitions as possible, stepping up and down on a 21-cm (GMFCS E&R levels I and II) or 12-cm (GMFCS E&R level III) step in 30 seconds.[20,33] Specifically, each participant was