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Reliability of the modified Gross Motor Function Measure-88 (GMFM-88) for children with both Spastic Cerebral Palsy and Cerebral Visual Impairment: A preliminary study☆

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ABSTRACT

Purpose: The aims of this study were to adapt the Gross Motor Function Measure-88 (GMFM-88) for children with Cerebral Palsy (CP) and Cerebral Visual Impairment (CVI) and to determine the test–retest and interobserver reliability of the adapted version.
Method: Sixteen paediatric physical therapists familiar with CVI participated in the adaptation process. The Delphi method was used to gain consensus among a panel of experts. Seventy-seven children with CP and CVI (44 boys and 33 girls, aged between 50 and 144 months) participated in this study. To assess test–retest and interobserver reliability, the GMFM-88 was administered twice within three weeks (Mean = 9 days, SD = 6 days) by trained paediatric physical therapists, one of whom was familiar with the child and one who wasn't. Percentages of identical scores, Cronbach's alphas and intraclass correlation coefficients (ICC) were computed for each dimension level.
Results: All experts agreed on the proposed adaptations of the GMFM-88 for children with CP and CVI. Test–retest reliability ICCs for dimension scores were between 0.94 and 1.00, mean percentages of identical scores between 29 and 71, and interobserver reliability ICCs of the adapted GMFM-88 were 0.99–1.00 for dimension scores. Mean percentages of identical scores varied between 53 and 91. Test–retest and interobserver reliability of the

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GMFM-88-CVI for children with CP and CVI was excellent. Internal consistency of dimension scores lay between 0.97 and 1.00.
Conclusion: The psychometric properties of the adapted GMFM-88 for children with CP and CVI are reliable and comparable to the original GMFM-88.

1. Introduction

Cerebral Palsy (CP) describes a group of permanent disorders of movement and posture development that cause activity limitations; they are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain. Gross motor function of children with CP is classified into five different severity levels using the Gross Motor Function Classification System (GMFCS), where level 1 indicates the least and level 5 the most functional limitation (Rosenbaum, Paneth, Leviton, Goldstein, & Bax, 2007). Motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour; by epilepsy; and by secondary musculoskeletal problems (Rosenbaum et al., 2007).

The spectrum of visual impairments in children with CP is broad and includes forms of ocular visual impairment (OVI) such as strabismus, reduced visual acuity, ocular nystagmus, refraction disorders and retinopathies; and Cerebral Visual Impairment (CVI), which is a problem of central origin. CVI is observed in approximately 30% of children diagnosed with various forms of CP (Da Costa, Salmao, Berezovsky, De Haro, & Ventura, 2004; Dutton & Jacobson, 2001; Ghasia, Burnstroom, Gordon, & Tychsen, 2008; Schenk-Rootlieb, Van Nieuwenhuizen, Van der Graaf, et al., 1993; Schenk-Rootlieb, Van Nieuwenhuizen, Schiemanck, et al., 1993; Schenk-Rootlieb, Van Nieuwenhuizen, Van Waes, & Van der Graaf, 1994; Stiers et al., 2002). CVI can be defined as deficient visual function, as a sequel of damage or malformation of the retrogeniculate visual pathways (optic radiations, occipital cortex and visual association areas) in the absence of damage to the anterior visual pathways or any major ocular disease. CVI is diagnosed by exclusion of OVI (Dutton & Jacobson, 2001; Dutton et al., 2004), and ranges in severity from blindness to relatively minor impairments of visual perception. Perceptual visual dysfunction and disorders of visual attention, often with only minimally reduced or normal visual acuities, are increasingly recognised as forms of CVI (Dutton, 2013; Dutton & Jacobson, 2001; Fazzi et al., 2012). Children with CVI exhibit slow, inefficient and highly variable visual performance during daily-life activities (Good, Jan, Burden, Skoczenski, & Candy, 2001). It is established that CVI has an impact on all aspects of a child's development, and children with both CP and CVI develop more slowly in the areas of self-care, mobility and social function than children with CP and without CVI. (Da Costa, Salmao, Berezovsky, De Haro, & Ventura, 2004; Dutton & Jacobson, 2001; Dutton, 2013; Ghasia et al., 2008; Good et al., 2001; Salavati, Rameckers, Steenbergen, & Schans van der, 2014; Schenk-Rootlieb, Van Nieuwenhuizen, Van der Graaf, et al., 1993).

The role of visual perception during motor action and development is very important because children with CP show increased visual monitoring during motor activities (reaching, walking, daily-life activities and play), and this emphasises the role of visual perception during motor action (Good et al., 2001; Guzzetta, Mercuri, & Cioni, 2001;Verrel, Bekkering, & Steenbergen, 2008; Palisano et al., 1997). Compared to their peers, children with CVI have inferior gross motor skill performance, are less physically active, and exhibit poor performance on static and slow dynamic balance tasks (Houwen, Hartman, & Visscher, 2009; Salavati et al., 2014, 2015). Early assessment and accurate detection of visual disorders is therefore of paramount importance in children with CP (Fazzi et al., 2012). Limitations in physical activities in children with CP may not be caused solely by a delay in motor or mental development but also by the presence of CVI (Salavati et al., 2014). As children with both CVI and CP experience limitations in daily activities (Da Costa et al., 2004; Salavati et al., 2014), it is important to evaluate their gross motor function.

The Gross Motor Function Measure-88 (GMFM-88) is used to measure changes in gross motor function in children with CP and has been commonly used by researchers (Chrysagis, Skordilis, Stavrou, Grammatopoulou, & Koutsouki, 2012; Scholtes et al., 2010). The GMFM-88 consists of 88 items in five dimensions: lying and rolling (GMFM-A); sitting (GMFM-B); crawling and kneeling (GMFM-C); standing (GMFM-D); and walking, running and jumping (GMFM-E). The GMFM-88 comprises 88 items, of which only seven were not found to be at the level of activities and participation of the ICF (WHO, 2001). (Engelen, Ketelaar, & Gorter, 2007) and are therefore not classified: Domain A: Lying and Rolling – item 1: Supine, head in midline: turns head with extremities symmetrically; item 3: Supine: lifts head 45 degrees; item 4: Supine: flexes right hip and knee through full range; item 5: Supine: flexes left hip and knee through full range; item 10: Prone: lifts head upright. Domain B: Sitting – item 21: sitting on mat, supported at thorax by therapist, lifts head upright, maintains for 3 s; item 22: Sitting on mat, supported at thorax by therapist, lifts head to midline, maintains for 10 s (Engelen et al., 2007; WHO, 2001).

The reliability and validity of this test are sufficient (inter-rater reliability: ICC = 0.75–1.00; test–retest reliability: ICC = 0.96–0.99) (Engelen et al., 2007; Ketelaar, Van Petegem-van Beek, Veenhof, Visser, & Vermeer, 2003). The GMFM-88 is a criterion-referenced instrument constructed to evaluate the development of motor skills in children with CP, designed and validated for these children by using principles of classical test theory. It is used widely as a clinical and research outcome measure and there is considerable evidence of its reliability, validity and responsiveness (Avery, Russell, Raina, Walter, &