



# Trends in **Medical Research**

ISSN 1819-3587



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## Development of the Persian Version of Gross Motor Function Measure-88 (GMFM-88): A Study of Reliability

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### ABSTRACT

The aims of this study were to cross-culturally translate and equivalence of the Gross Motor Function Measure 88 (GMFM-88) in to Persian and to evaluate its reliability in 50 children with Cerebral Palsy (CP). Our investigation was a none-experimental and methodological study which developed a Persian translation of the GMFM-88 based on International Quality of Life Assessment (IQLA) guidelines. Inter-rater reliability was performed by comparison of scores recorded by two expert physiotherapists in a blind pattern while inter-rater reliability was assessed by comparison of scores recorded by an expert physiotherapist in two continuous weeks. Intra-class Correlation Coefficient (ICC) was used to evaluate both reliabilities. Additionally internal consistency was calculated using Cronbach's alpha coefficient. The ICC was 0.99 for both inter-rater reliability and intra-rater reliability with 95% Confidence Interval (CI) = 0.99-1. Cronbach's alpha coefficients for all dimensions of the GMFM-88 were ranged 0.78-0.94, which showed an acceptable internal consistency. The Persian version of the GMFM-88 which indicated high internal consistency is a reliable instrument to quantify gross motor function in children with CP and to follow efficacy of various rehabilitation and medical treatments in these patients.

**Key words:** Cerebral palsy, GMFM-88, reliability, internal consistency

### INTRODUCTION

Cerebral Palsy (CP) as one of the most common reasons of physical disability in childhood originates from none-progressive brain injuries or abnormalities of brain development and results in posture, movement and co-ordination impairments (McCullough *et al.*, 2013; Papavasiliou, 2009). Prevalence of this disease was estimated at 2-2.5 cases in 1000 born. The CP impairs not only motor development but also the daily activities in patients (Tseng *et al.*, 2011). Gross motor

function impairments such as disorders in sitting, walking, walking up stairs and standing are major problems in CP patients and negatively affect patient activities including daily living skills, self-care and social communications. Hence, recovery of gross motor function which greatly improve individual and social skills in children with CP is one of the most important goals in therapy protocols (Khayat-zadeh and Karimloo, 2010).

Although, investigators have tried to evaluate efficacy of various treatment interventions, lack of a strong and reliable criteria for assessment of post-treatment changes (Ellis, 2013). Palisano *et al.* (2000) designed gross motor function classification system (GMFCS) which is an objective classification of the patterns of motor disability in children with CP. However, precise measurement of the motor changes for evaluating of the motor development and treatment efficacy should be prepared along with a standard gross motor function classification system (Wang and Yang, 2006).

The Gross Motor Function Measure (GMFM) proposed by Russell *et al.* (1989) is a criterion-referenced evaluation means for detecting changes in the gross motor function during treatment procedure in children with CP (Russell *et al.*, 1989; Wang and Yang, 2006). The GMFM was designed and validated based on principles of classical test theory and is broadly used by clinicians and researchers (Avery *et al.*, 2003). This measure method with good validity and reproducibility is routinely used in children with CP aged between 5 months to 16 years (Nelson and Senesac, 2007).

Currently there are two versions of the GMFM i.e. the GMFM-88 and GMFM-66. GMFM-88 is a criterion-reference survey composed of 88 items which were categorized into 5 gross motor function dimensions including lying and rolling (17 items), sitting (20 items), crawling and kneeling (14 items), standing (13 items) and walking, running and jumping (24 items). This method was principally provided to detect clinically significant changes of gross motor functions in children with CP (Linder-Lucht *et al.*, 2007). All of the items can be carried out by an intact 5 years old child without any motor delay. Each item consist of four scores including 0 (inability to start action), 1 (ability to start action and to perform 10% of the activity), 2 (ability to perform 10% to <100% of the activity) and 3 (ability to perform activity completely) (Shamsoddini, 2010). Additionally validity and reproducibility of the GMFM scores was confirmed and recorded in children with CP (Palisano *et al.*, 2000). GMFM-66 is newer version of the GMFM reduced and corrected difficulties of previous version (Linder-Lucht *et al.*, 2007).

Both versions of the GMFM are translated into the various languages such as Dutch, Spanish, Thai, Korean and Indonesian and widely used for assessing gross motor function (Mahasup *et al.*, 2011; Park *et al.*, 2011; De Azpillaga *et al.*, 2009; Selly *et al.*, 2011; Veenhof *et al.*, 2003). Measure methods as well as GMFM need to be clinically reliable, relevant and valid where these criteria are achieved using a standardized translated version (Avery *et al.*, 2003). Although, any comprehensive study didn't evaluated epidemiology of the CP in Iranian population, because of some significant risk factors such as cousin marriage, pre-natal and post-natal diseases and negative conditions during delivery, a high rate of CP is expected in Iranian population (Shamsoddini and Hollisaz, 2009). For such reasons, in this study we tried to design a Persian version of the GMFM-88 and to evaluate its reliability and its internal consistency in 50 children with CP.

## **MATERIALS AND METHODS**

Current study was a none-experimental methodological study which evaluated inter-rater reliability, intra-rater reliability and internal consistency of the Persian version of GMFM-88 in 50 children with CP aged between 3-10 years.

**Samples:** Samples were selected from the children with CP aged between 3-10 years referred to the private clinics in Tehran city using random sampling method. Patients' parents had to sign a form stating that enough information had been given about the procedure. Patients undergoing a specific treatment or surgery interfering with gross motor function were removed from the study. Additionally, if patients' parents didn't sign consent form or if patient had disabling diseases other than CP, patient would be eliminated from the study. The current study was approved by ethical committee of the Ahvaz Jundishapur University of Medical Sciences (AJUMS).

**Stages of translation and cross cultural equivalence:** Considering Iranian languages and Iranian culture criteria, translation of the GMFM-88 into Persian version was performed in a number of stages. All the translation steps were done based on IQLA guidelines. Original version of GMFM-88 was translated into Persian version by two native translators independently. Then final Persian version was extracted from primary translated drafts after addressing investigators comments and translator comments. At next stage, Persian version of GMFM-88 was translated into English version by a native translator. Final English version was also provided from new English draft after addressing investigators comments and translator comments. Finally, our English version of GMFM was approved by designer of the GMFM (Beaton *et al.*, 2000).

**Reliability and internal consistency:** The GMFM-88 items were scored for 50 children with CP by two expert physiotherapists with 5 years of experience independently between September-2013 and January-2014. Inter-rater reliability was performed by comparison of scores recorded by two experts in a blind pattern. Because there is no significant change in gross motor function of the patients with CP in two continuous weeks (Russell *et al.*, 1989), inter-rater reliability was assessed by comparison of scores recorded by an expert in two continuous weeks. Inter-rater reliability and Intra-rater reliability was calculated using Intraclass Correlation Coefficient (ICC) with 95% confidence interval (Wang and Yang, 2006). The ICC values higher than 0.75 was acceptable (Russell *et al.*, 1989). Internal consistency was measured with Cronbach's alpha coefficient. A Cronbach's alpha coefficient higher than 70% was considered acceptable (Terwee *et al.*, 2007).

**Statistical analysis:** Data was analyzed using SPSS.21 statistical package (Chicago, USA). Frequency of the data was described as Mean $\pm$ SD values for continuous variables and as proportions for categorical data. Inter-rater reliability, intra-rater reliability and internal consistency were calculated as described above.

## RESULTS

During designing Persian version of the GMFM-88, there are problems with providing Persian equivalent for some words in some items such as pivot in lining/rolling section and propping in sitting item. Since, GMFM-88 is a therapy-based survey, no major revision was needed to do on new Persian version. However, we added an explanation for questions no. 49, 50, 60 and 61 in crawling and kneeling and standing dimensions. After translating Persian version into the English version and then confirming by designer of the GMFM, standard Persian version of the GMFM-88 was approved and used for assessing gross motor function in children with CP.

Mean age of the studied children was 7.26 $\pm$ 2.54 years. Results of demographic analyses in the studied patients were summarized in Table 1.

Table 1: Demographic analysis of the 50 children with CP used in our investigation

Variables	Values
<b>Demographic</b>	
Age (Mean±SD)	7.26±2.54
Male	23 (46%)
Female	27 (54%)
<b>Affected areas</b>	
Quadriplegia	22 (44%)
Diplegia	20 (40%)
Hemiplegia	8 (16%)
<b>Type of CP</b>	
Spastic	44 (88%)
Athetoid	0 (0%)
Flaccid	6 (12%)

Table 2: Intraclass correlation coefficients for inter-rater and intra-rater reliability

Dimensions	Intra-rater (n = 50)		Inter-rater (n = 50)	
	ICC	Confidence interval (95%)	ICC	Confidence interval (95%)
Lying and rolling	0.99	0.98-0.99	0.98	0.97-0.99
Sitting	0.99	0.97-0.99	0.97	0.96-0.99
Crawling and kneeling	0.99	0.98-0.99	0.99	0.98-0.99
Standing	0.99	0.98-0.99	0.99	0.98-0.99
Walking/running/jumping	0.99	0.99-1.00	0.99	0.98-0.99
Total	0.99	0.99-1.00	0.99	0.99-1.00

ICC: Interclass correlation coefficient

Table 3: Cronbach's alpha coefficients for various dimension

Dimensions	Cronbach's alpha coefficient
Lying and rolling	0.78
Sitting	0.93
Crawling and kneeling	0.94
Standing	0.92
Walking/running/jumping	0.90
Total	0.90

Intraclass Correlation Coefficient (ICC) for inter-rater reliability and intra-rater reliability were 0.99 (with 95% CI = 0.99-1). Inter-rater reliability ICC for all dimensions was between 0.97-0.99 while, intra-rater reliability ICC for all dimensions was 0.99 (Table 2). All calculated ICC values were higher than 0.75 revealing an acceptable inter-rater reliability and intra-rater reliability for this measure (Russell *et al.*, 1989). Additionally Cronbach's alpha coefficient for all dimensions was above 0.78 (Table 3).

## DISCUSSION

One of the most important steps of validity of a measure method is assessing its reliability (Carter *et al.*, 2011). Our study indicated that Persian version of the GMFM-88 designed by our research team had acceptable reliability and internal consistency for evaluating gross motor function of children with CP.

Our findings indicated that Persian version of GMFM-88 had excellent inter-rater reliability and intra-rater reliability (Table 3). Similar findings reported by Ko and Kim (2013), where ICC of the inter-rater reliability and intra-rater reliability were calculated 0.97 and 0.95 respectively. Since, we evaluated inter-rater reliability between two physiotherapists, ICC value was higher than ones reported by Ko and Kim (2013), who evaluated inter-rater reliability between ten physiotherapists. Furthermore, ICC value for intra-rater reliability in our investigation was higher

than ICC value reported by Ko and Kim (2013). Discrepancy of these findings can be explained by intra-rater reliability time intervals which were one week and one month for our study and Ko and Kim (2013) study, respectively.

Additionally in agreement with our results, ICC of the inter-rater reliability and intra-rater reliability were reported by Russell *et al.* (2002) as 0.87-0.99 and 0.92-0.99 respectively. The ICC of the inter-rater reliability and intra-rater reliability in Dutch translation of GMFM were 0.99. Mahasup *et al.* (2011) designed Thai translation of GMFM-66 suggested a value of 0.93 for ICC of the inter-rater reliability and a value of 0.99-1 for ICC of intra-rater reliability. However, their sample size was relatively small (n = 10) which reduced reliability of their results.

Our findings were also indicated high internal consistency for Persian translation of GMFM-88. In agreement with our results, Selly *et al.* (2011) developed Indonesian translation of GMFM-88 reported Cronbach's alpha coefficient = 0.88. Park *et al.* (2011) evaluated validity of the Korean translation of GMFM using Rasch analysis method. They reported Person separation reliability index as analogous of Cronbach's alpha coefficient to be 0.99. Recent investigations revealed that Cronbach's alpha coefficient can be also used for estimation of reliability (Ellis, 2013).

In conclusion our results concerning reliability and internal consistency confirmed Persian translation of GMFM-88 as an acceptable gross motor function measure method in children with CP. However, there were some limitations in our study. For example, assessment conditions weren't similar for all studied patients. Future studies can be focused on evaluation of this measure method in patients with other various gross motor function disorders such as children with Down syndrome or children or adults with brain injury.

## **ACKNOWLEDGMENTS**

The present study was extracted from a thesis by Atefe Keshavarz and supported by a grant from the Ahvaz Jundishapur University of Medical Sciences (AJUMS) [No. Pht-9204]. Authors wish to thank families of the children with CP because of their patients and cooperation.

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