



Original Article

Validating the Reliability and Validity of the Persian Version of the Mini-Manual Ability Classification System

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ARTICLE INFO

Article History:

Received: 04/09/2022

Revised: 21/11/2022

Accepted: 16/04/2023

Keywords:

Cerebral palsy

Classification system

Manual ability

Reliability

Validity

Please cite this article as:

Riyahi A, AkbarFahimi N, Sarlak N, Abdolrazaghi H, Nobakht Z. Validating the Reliability and Validity of the Persian Version of the Mini-Manual Ability Classification System. *JRSR*. 2023;10(4):203-208. doi: 10.30476/JRSR.2023.96667.1322.

ABSTRACT

Background: Cerebral Palsy (CP) refers to a collection of lifelong conditions that affect a child's development and posture, limiting their ability to engage in various activities. Many children with CP encounter various upper extremity issues that can vary in severity. Recognizing the capabilities of children under the age of 4 is of utmost importance. Therefore, the objective of this study was to create a Persian version of the mini-Manual Ability Classification System (mini-MACS) and assess its validity and reliability.

Methods: In this methodological study, the Persian version of the mini-Manual Ability Classification System (mini-MACS) underwent a series of assessments to evaluate its validity and reliability. The study included procedures for translation, face validity, and content validity, as well as tests for test-retest reliability and interrater reliability. The evaluation of the scale's reliability involved the participation of 100 parents of children with cerebral palsy, 12 occupational therapists, and one researcher. The study encompassed 56 boys and 44 girls diagnosed with cerebral palsy, with an average age of 33.21 months (SD=11.37).

Results: The comprehensive findings from the study demonstrated that the words and sentences employed in the mini-Manual Ability Classification System (mini-MACS) were straightforward, lucid, comprehensible, pertinent, and essential. The Intraclass Correlation Coefficients (ICCs) for the test-retest reliability were notably high, with values of 0.955 for parents, 0.979 for occupational therapists, and 0.943 for the researcher. In terms of interrater reliability, the coefficients exhibited strong agreement. The coefficient between parents and occupational therapists was 0.939, between parents and the researcher was 0.954, and between occupational therapists and the researcher was 0.922.

Conclusion: The Persian version of the mini-Manual Ability Classification System (mini-MACS) appears valid and reliable. This system can be effectively utilized to assess children with cerebral palsy.

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Introduction

Cerebral Palsy (CP) is a term used to describe a group

of persistent developmental and postural disorders that result in limitations in a person's ability to carry out various activities. CP is typically associated with non-progressive disruptions during fetal or early infancy, affecting the developing brain [1, 2]. This condition is observed in approximately 2-2.5 out of every 1000 live births [1, 3, 4]. CP manifests as reduced muscle strength,

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a lack of control over rapid coordinated movements, involuntary muscle movements, spasms, poor postural control, and limited mobility [5, 6]. More than half of children with CP face various upper extremity challenges, varying in severity [5, 7].

Hand function is paramount in daily life [8, 9]. Children with CP often encounter difficulties performing manual tasks, such as grasping, releasing, and manipulating objects, which are crucial for many activities of daily living [10]. These children may have fewer opportunities to interact with their environment and experience the consequences of their actions [11]. Consequently, their engagement in activities like self-care, playing with peers, and completing school assignments can be hindered [12].

Over the past two decades, the classification of children with CP has evolved, considering factors such as the location of central control and brain involvement, the nature and type of motor disorders, physiological (anatomical) distribution, and functional motor abilities. However, the physiological classification and topographic distribution alone do not provide a comprehensive understanding of a child's performance and abilities, as per the International Classification of Functioning, Disability, and Health (ICF) framework. Therefore, it has become essential to classify the functional performance of the upper and lower limbs separately using objective functional scales [13].

Various classification systems have been developed to address manual functions, including the House classification, modified House classification, and Zancolli classification [14]. Another group of classification systems focuses on manual functional capacity. However, none of these systems adequately describe hand function in everyday routines. Consequently, there was a need for a simple and practical instrument that emphasizes daily activities [15].

In recent years, functional categories have gained prominence in describing the diverse group of children with CP. In 1997, the Gross Motor Function Classification System (GMFCS) was introduced, followed by the Manual Abilities Classification System (MACS), to classify children with CP based on their functional abilities [16]. Subsequently, other classification systems have been developed, such as the Communication Function Classification System (CFCS) [17] and the recently introduced Visual Function Classification System (VFCS) [18], all aiming to classify children with CP based on their functional abilities [19].

MACS was initially introduced by Penta et al. in 2001, and Eliasson et al. further developed the final structure of MACS based on the concept of the GMFCS [16]. MACS stands as a significant tool for classifying children with CP, and it focuses on assessing hand function related to manipulating objects during daily activities in children aged 4 to 18 years. This system offers a novel perspective for classifying the functional abilities of children and adults with CP concerning the use of objects in their daily lives. It is crucial to note that MACS is performance-based rather than skill-based.

The MACS system evaluates developmentally appropriate activities for a child's age. It assesses them in

the context of essential daily activities like play, leisure, eating, dressing, and the ability to handle objects. It excludes activities requiring advanced skill training, such as playing a musical instrument. MACS categorizes both hands simultaneously and does not differentiate between hands concerning their capability. When determining a child's MACS level, the focus is on their actual performance rather than their maximum ability. MACS specifically concentrates on manipulating objects within one's immediate personal space adjacent to the body and does not include activities involving objects that are out of reach. This approach minimizes the influence of gross motor function limitations as a potential confounding factor, distinguishing it from other assessment tools [16].

Children typically require frequent assistance with their manual activities at the age of three, and the tasks they engage in are generally less complex than older children. The Mini-Manual Ability Classification System (mini-MACS) was introduced by Eliasson et al. in 2016 as a classification system specifically designed for assessing manual abilities in young children under four years of age [20]. Given the significance of evaluating manual abilities in children within this age group and the widespread use of the Persian language, primarily in Iran, Afghanistan, and Tajikistan, with a large population of Persian speakers worldwide, the objective of this study was to develop a Persian version of the mini-MACS and assess its validity and reliability.

Methods

A methodological and cross-sectional design was employed to fulfill the objectives of this study [21-23].

Translation and Validity

After obtaining permission from the developer, the mini-MACS was translated into Persian in three steps following the International Quality of Life Assessment protocol (IQOLA) [24]. First, two independent translators, both fluent in Persian and English, translated the original version of the mini-MACS from English to Persian and assessed the translation's difficulty. Subsequently, the initial Persian version was created by selecting the best translation within the research group. In the next step, two English language experts, proficient in Persian, evaluated the quality of the forward translation in terms of clarity, language suitability, cultural relevance, and conceptual equivalence. The second Persian version was revised based on the research team's recommendations. This revised version was then back-translated into English by two English language translators. The back-translated version was compared to the original English version. The final English back-translated version was shared with the developer, who provided valuable suggestions. All the suggestions were implemented with the developer's permission and approval, resulting in the final Persian version of the scale.

Validity refers to the extent to which a test accurately measures what it is intended to measure. Various types of validity include face validity, content validity, construct validity, criterion-related validity, formative validity,

and sampling validity [22, 25]. In this study, face and content validity were assessed by a panel of experts, including therapists and parents of children with CP. These participants were asked to evaluate each item on the scale for “clarity,” “understandability,” “relevance,” and “necessity” using a Likert scale that ranged from 1 (not at all) to 4 (perfectly). The Content Validity Index (I-CVI) was calculated to determine the content validity of all items and scale levels.

Reliability

Reliability refers to the consistency and stability of results produced by an assessment tool. Various types of reliability include test-retest reliability, parallel forms reliability, interrater reliability, and internal consistency reliability [22, 25]. In this study, both test-retest and interrater reliability were assessed to evaluate the reliability of the Persian version of the mini-MACS.

Participants and Process

Parents who met the following criteria were included in the study: they needed to be literate and have a child diagnosed with CP by a neurologist between 1 and 4 years old. Additionally, occupational therapists with a bachelor’s degree or higher who were willing to participate in the study were included. Participants were excluded if they were unwilling to continue their cooperation at any study stage. To ensure an adequate sample size, at least 100 children with CP aged 1-4 years were considered for the study, considering the limitations in the available statistical population and samples [20, 26, 27].

Parents and therapists were recruited through convenience sampling. They were provided with the Mini-MACS questionnaire and a demographic questionnaire to complete. One hundred parents and 12 therapists participated in this study, with participants coming from 5 private and four government clinics and hospitals in Arak, Iran. To assess interrater reliability, each child with CP was evaluated by different assessors, including the researcher, the child’s parent, and an occupational therapist. The researcher and occupational therapist determined the child’s Mini-MACS level through direct observation and by asking questions to the parents.

A second assessment was conducted four weeks later for all participating children to evaluate test-retest reliability. This involved observing the child and questioning the parents again. The appropriate time interval between the two testing sessions was determined based on factors such as the stability of the construct over time and the characteristics of the target population [28, 29]. All data collected were then analyzed using IBM SPSS version 22 software.

This study was registered with the registration number IR.ARAKMU.REC.1397.039, and informed consent was obtained from all participants.

Scale

Mini-Manual Ability Classification System (mini-MACS)

The Mini-MACS is a valuable scale for classifying the use of hands in manipulating objects during everyday activities in children with CP aged 1 to 4 years. Children are assigned to one of the five Mini-MACS levels based on

their ability to manipulate objects and the amount of help or adjustments needed for manual activities in daily life. There are five levels and four distinctions between levels in the Mini-MACS. Level I represents the best manual ability, while Level V indicates a lack of active manual function [20]. The Mini-MACS has been translated into more than ten languages, and its validity and reliability have been tested in these translated versions [30].

Statistical Analysis

Descriptive statistics, including frequencies and descriptive measures, were employed to determine the demographic characteristics of the study participants. Weighted kappa and correlation coefficient analyses were conducted to assess the reliability of the Persian version of the Mini-Manual Ability Classification System.

Results

The demographic characteristics of the study participants are summarized in Table 1. The study included 100 parents of children with cerebral palsy. Out of these children, 56 were boys, and 44 were girls. The average age of these children was 33.21 months (SD=11.37), indicating some variability in the ages of the participants. The study also involved 12 occupational therapists, four men and eight women, with an average age of 35.15 years. On average, these therapists had 80.30 months of work experience (SD=63.93). They also had an average of 75 months of experience working specifically with children with cerebral palsy (SD=64.96).

Translation and Validity

The face and content validity of the Persian version of the Mini-MACS were assessed. Face validity was evaluated using the item impact method, presenting each scale level to 20 parents and 20 therapists. They were asked to rate the importance of each level on a 5-point Likert scale, with the options: “Completely important” (Score 5), “Important” (Score 4), “Moderately Important” (Score 3), “Slightly Important” (Score 2), and “Not important” (Score 1). The impact score for each item was calculated by multiplying the frequency of each rating by its corresponding importance score. If the calculated impact score for an item was greater than 1.5, it was considered suitable, indicating that it was important and relevant. These items were retained for the Persian version of the Mini-MACS (31). The Persian version of the Mini-MACS is available for free access at the following link: <https://www.macs.nu>.

The content validity of the Persian version of the Mini-MACS was assessed using two common indices: the Content Validity Ratio (CVR) and the Content Validity Index (CVI). Both parents and therapists were asked to assess each item on the scale and indicate whether the item was “necessary,” “useful but not necessary,” or “not necessary.”

The determination of which items to accept or reject for the Persian version of the Mini-MACS was based on specific criteria involving the CVR and the impact factor, as previously described. If the CVR value of an item is equal to or greater than 0.42, the item is accepted.

Table 1: Demographic characteristics of participants

			Frequency	Percentage
Child (n=100)	Sex	Male	56	56
		Female	44	44
	Diagnosis	Monoplegia	7	7
		Hemiplegia	27	27
		Diplegia	19	19
		Quadriplegia	45	45
		Tetraplegia	1	1
		Double hemiplegia	1	1
	Seizure	Yes	51	51
		No	49	49
	Trauma	Yes	23	23
		No	77	77
	Visual deficit	None	81	81
		Deficit	12	12
		Blind	7	7
Auditory deficit	None	86	86	
	Deficit	3	3	
	Deaf	11	11	
Mental disability	Yes	60	60	
	No	40	40	
Parents (n=100)	Mother's level of education	Under diploma	28	28
		Diploma	39	39
		BCh	28	28
		MSc	5	5
	Main caregiver	Father	3	3
		Mother	91	91
		Nurse	4	4
		Other	2	2
Occupational therapist (n=12)	Sex	Male	4	33.4
		Female	8	66.6
	Education level	BCh	4	33.4
		MSc	5	41.6
		PhD	3	25.0

If the CVR value of an item falls between zero and 0.42, and the item's impact factor is greater than 1.5, the item is accepted. If the CVR value of an item is less than zero and the item's impact factor is less than 1.5, the item is rejected [31]. In this study, all items were found to have impact scores exceeding 1.5 (Table 2). As a result, all items met the criteria for acceptance. The scores of the levels surpassed the threshold score (0.42) of the Lawshe table, suggesting that the tool contains relevant items that hold significant statistical significance ($P < 0.05$).

The determination of content validity was further assessed by calculating the CVI using the Waltz & Bausell method [32]. The CVI measures items' relevance, clarity, and simplicity to ensure that they meet the necessary standards of content validity. Participants were asked to evaluate each item based on three criteria, and they used a 4-part Likert scale to rate the items. The three criteria they assessed were relevance or propriety, simplicity and fluency, clarity or transparency. The CVI score was then computed for each criterion using the respective formula.

The results showed that the relevance or specificity of the items scored higher than 0.79, indicating that these items were deemed highly relevant and appropriate. Moreover, some items' Clarity (transparency) and simplicity scored between 0.70 and 0.79 (Table 3). These scores indicate that while the items are generally clear and simple, some may require revision or correction to meet the preferred content validity standards. Based on these

results, the research team made the necessary corrections to the items, ensuring they met the established content validity standards.

Reliability

Spearman correlation coefficient, agreement coefficient, and Kappa were computed to assess the scale's reliability. The findings indicate that the scale exhibits strong reliability. As measured by the ICC, the test-retest reliability was 0.955 for parents, 0.979 for occupational therapists, and 0.943 for researchers. The interrater reliability coefficients were 0.939 between parents and occupational therapists, 0.954 between parents and researchers, and 0.922 between occupational therapists and researchers (Table 4).

Discussion

The study results revealed that the impact score of all items was acceptable, and all items were suitable. The CVR score of all items exceeded the Lawshe table score, and all the items were accepted. The relevance or specificity of the items was appropriate. Still, the clarity (transparency) and simplicity of some items required correction, and the items were revised according to the suggestions of the research team. The Intraclass Correlation Coefficient (ICC) for test-retest reliability for parents, occupational therapists, and researchers was very good.

Table 2: Item Importance, CVR and CVI score

Item	Parents			Therapist		
	Importance score	CVR	CVI	Importance score	CVR	CVI
Goal		0.9	1		0.7	1
Userguide		0.7	1		0.7	1
Level 1	5	0.8	1	4.25	0.8	1
Distinctin 1,2	4.5	0.9	1	4.5	0.9	1
Level 2	4.75	0.9	1	5	0.9	1
Distinction 2,3	5	0.5	1	4.5	0.5	0.85
Level 3	5	0.9	1	4.25	0.9	1
Distinction 3,4	4.75	1	1	4.5	1	1
Level 4	4.5	0.9	1	4.5	0.9	1
Distinction 4,5	4.25	0.9	1	4.5	0.9	1
Level 5	5	0.6	1	4.25	0.6	1

Table 3: Item relevance, simplicity and clarity score

Item	Parents			Therapist		
	Relevance	Simplicity	Clarity	Relevance	Simplicity	Clarity
Goal	1	0.85	0.9	0.85	0.75	0.9
Userguide	0.9	0.8	0.8	0.9	0.85	0.85
Level 1	1	0.8	1	0.9	0.75	0.95
Distinctin 1,2	1	0.95	0.95	0.9	0.85	0.95
Level 2	0.9	0.9	1	0.9	0.75	0.85
Distinction 2,3	0.85	0.9	1	0.8	0.75	0.85
Level 3	1	1	0.95	0.8	0.7	0.85
Distinction 3,4	0.95	0.95	1	0.85	0.8	0.75
Level 4	1	1	1	0.85	0.8	0.8
Distinction 4,5	0.95	0.9	1	0.85	0.9	0.75
Level 5	0.95	0.95	1	0.9	0.75	0.75

Table 4: Result of test–retest and Interrater reliability

	Interclass correlation coefficient	P value	Spearman correlation coefficient	Concordance correlation coefficient	kapaa
Test–retest reliability					
Minimacs parent	0.955	0.109	0.959	0.9589	0.918
Minimacs researcher	0.943	0.057	0.965	0.9694	0.930
Minimacs therapist	0.979	0.134	0.949	0.9523	0.918
Interrater reliability					
		Concordance correlation coefficient		Weighted kappa	
Parent/researcher	0.954	0.928		0.863	0.758
Parent/therapist	0.939	0.929		0.864	0.785
Researcher/therapist	0.922	0.933		0.876	0.720

After the development of MACS and its application in various studies, a need arose to classify the manual ability of younger children displaying signs of CP. Researchers and policymakers were interested in having scales that could predict manual ability development in these children. Eliasson et al. conducted a study that expanded MACS to include children under four. They developed and evaluated Mini-MACS for children less than four years old. A sample of children with CP was assessed using scores from one parent and two therapists. The ICC between the therapists and parents' scores and between the therapists was very good.

While the first sentence of the five levels of MACS was retained, other sentences were adapted to be more relevant to the younger age group. Parents and therapists found the descriptions in Mini-MACS to be appropriate and understandable, making this system applicable for children with CP under four years old [20]. It's worth noting that Mini-MACS has been translated into more

than ten languages. A three-step translation process was carried out to create the Persian version following the International Quality of Life Assessment protocol. Impact scores and CVR were calculated to assess the face validity and content validity of the scale. The results demonstrated that the Persian version of Mini-MACS exhibits acceptable face validity and content validity.

After developing a scale, assessing the tool's reproducibility, or the extent to which repeated measurements yield consistent results, is crucial. In the case of mini-MACS, interrater reproducibility studies have employed various metrics such as the ICC, weighted kappa, and the agreement statistic 'rater agreement,' which represents the percentage of absolute agreement.

Previous research reported excellent interrater reliability of the mini-MACS (ICC=0.97; absolute agreement=89%; n=61; age=12–51 months). However, it was noted that the agreement between raters was less robust when assessing children at mini-MACS levels III

and IV, which may be attributed to smaller sample sizes in these category levels. Weighted kappa and correlation coefficient analysis were also used in our study to estimate reliability, and the results indicated that the scale exhibits good reliability.

This is consistent with findings from the present study. Moreover, the ICC for test–retest reliability among parents, occupational therapists, and researchers was very good [30]. Notably, the Greek version of Mini-MACS demonstrated excellent test-retest reliability for both therapists and parents, and similar results were observed in the Chinese version of Mini-MACS [33].

The interrater reliability coefficients between parents and occupational therapists, parents and the researcher, and between occupational therapists and the researcher demonstrated acceptable agreement. These results align with the interrater reliability findings of the Greek Mini-MACS, the original Swedish Mini-MACS, and the Chinese Mini-MACS [20, 30, 33].

Due to the lack of a suitable system for recording children's information, access to the participants was limited, so sampling was used in an accessible way.

Conclusion

The Persian version of the Mini-MACS appears valid and reliable, making it a suitable tool for evaluating children aged between 1 and 4 years old with cerebral palsy.

Acknowledgment

The authors thank the therapists and families who participated in this study.

Funding

This project is financially supported by the Arak University of Medical Sciences.

Conflict of Interest: None declared.

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