



Original Article

Relationship between gross motor function and the function, activity and participation components of the International Classification of Functioning in children with spastic cerebral palsy

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Abstract. [Purpose] This study aimed to evaluate the relationship between gross motor function, measured using the Gross Motor Function Measure (GMFM), Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and Functional Independence Measure for Children (WeeFIM), and Function, and Activity and Participation components of the International Classification of Functioning, Disability, and Health-Child and Youth Check List (ICF-CY) in children with spastic cerebral palsy (CP). [Subjects and Methods] Seventy-seven children with spastic CP participated in the study. The GMFM, GMFCS, MACS, and WeeFIM were administered in their entirety to patients without orthoses or mobility aids. The ICF-CY was used to evaluate the degree of disability and health. [Results] The score of the ICF component of Activity and Participation had a significantly strong correlation with the scores of GMFM, GMFCS, MACS, WeeFIM, and ICF component of Function. [Conclusion] When establishing a treatment plan for children with spastic CP, the children's physical abilities, and their limitation in activity, performance, and participation, which would be measured using the ICF-CY, should be taken into consideration.

Key words: Spastic cerebral palsy, Gross motor function, International classification of functioning

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INTRODUCTION

The International Classification of Functioning, Disability, and Health (ICF) is a classification system for health and health-related domains¹⁾. Since an individual's functioning depends greatly on their context, the ICF also considers a list of environmental factors. ICF is the WHO framework for measuring health and disability at both individual and population levels. The International Classification of Functioning, Disability, and Health for Children and Youth (ICF-CY) is a WHO-approved derived classification based on the ICF designed to record the characteristics of developing children and examine the influence of children's environment on their health²⁻⁴⁾.

Children with cerebral palsy (CP) are undoubtedly restricted in their daily activities and ability to participate⁵⁾. Their condition not only limits their social participation but is also a crucial aspect that decides their overall quality of life⁶⁾. Affected children's activity and participation vary depending on the severity of their condition, age, self-management, and movement and function in society⁷⁾. For children, motor functionality does not depend solely on physical capability; it also depends on their basic ability to adapt to their environment via interactions with others. If children cannot adapt, their motor functionality will be hindered and they will not gain adequate experience, which will in turn delay their sensory and perceptual development, the growth of their motor conception, and growth of their sociality⁸⁾. Consequently, the children's activities

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and participation in their respective communities will be hampered⁹).

The purpose of treatment for a child with CP is to facilitate motor function whereby he/she can engage in activities and participate in the community. The present study aimed to compare scores of the Gross Motor Function Measure (GMFM), Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and Functional Index Measure (WeeFIM) with those of the components of Function and Activity and Participation of the ICF-CY among children with spastic CP. The findings are important in order to establish realistic treatment goals and intervention plans to encourage children with spastic CP to engage in activities and participate in the community.

SUBJECTS AND METHODS

Seventy-seven children with spastic CP participated in this study. The inclusion criteria for children with CP was as follows: spastic type of CP, ability to comply with researchers' and guardians' instructions, and permission from parents for the study. Children were excluded if they had newly developed neurological problems or musculoskeletal disorders, less than 6 months prior to the study start date, and if they had received botulinum-toxin or baclofen treatment, 3 months prior to the study start date. The present study was approved by the Sahmyook University Institutional Review Board. The objective of the study and its requirements were explained to the subjects, and the parents/guardians of all participants provided written consent, in accordance with the ethics principles of the Declaration of Helsinki. The general subject characteristics were as follows: 49 boys and 28 girls; mean age, 7.9 ± 2.26 years; mean height, 119.1 ± 7.16 cm; and mean weight, 23.5 ± 14.1 kg.

The GMFM was used to assess subjects' gross motor function. This measure comprises 5 dimensions: (A) lying and rolling; (B) sitting; (C) crawling and kneeling; (D) standing; and (E) walking, running, and jumping. Children were scored on all test items, and each item received a score of 0 to 3 with specific descriptors for each score. A score of 3 indicates better performance than a score of 0. The GMFM has demonstrated good intra- ($r=0.77$ or 0.88) and inter-rater ($r=0.68$) reliability^{10, 11}.

The MACS can be used to describe how well children with CP use their hands to handle objects during activities of daily living. It is useful for children between 4 and 18 years of age. It classifies manual function into 5 levels. Each level is divided into the following categories: ability to handle objects alone during activities of daily living, degree of required assistance, and ability to adapt to perform manual activities. The MACS is used to assess the ability to handle objects, the need for adaptation, and the degree of assistance required to perform movement tasks^{12, 13}.

The WeeFIM was used to assess subjects' functional abilities. It consists of a minimal data set of 18 items that measure functional performance in three domains: self-care, mobility, and cognition. The WeeFIM has good intra-rater agreement for the motor and cognitive scales ($r=0.98$ and $r=0.93$, respectively)¹⁴.

The ICF-CY checklist was used to evaluate the degree of disability and overall health condition of the subjects. This study only shows results pertaining to the components of (1) Function and (2) Activity and Participation from among the components included in the ICF-CY. The Function component includes body functions, that is, mental function, sensory function and pain, voice and speech function, cardiovascular system function, and motor activity-related function. The Activity and Participation component consists of 9 domains, including learning and applying knowledge, general task and demands, communication, self-care, and interpersonal interactions and relationships. Each domain is rated from "0" (no difficulty in performing) to "4" (complete assistance required for every aspect of the task)¹⁻⁴.

All statistical analyses were performed using SPSS 21.0. The general characteristics are presented as the average and standard deviation. Measured outcomes were evaluated relative to subjects' characteristics using the t-test, analysis of variance (ANOVA), and post-hoc Scheffe test. Pearson correlation analyses were performed to investigate the associations among scores of the GMFM, GMFCS, WeeFIM, and MACS and those for the Function and Activity and Participation components of the ICF. Results with $p<0.05$ were considered statistically significant.

RESULTS

Compared to children with quadriplegic and diplegic CP, those with hemiplegic CP had significantly higher GMFM scores ($F=48.492$, $p<0.001$), WeeFIM scores ($F=24.490$, $p<0.001$), ICF Function scores ($F=4.484$, $p<0.05$), and ICF Activity and Participation scores ($F=10.568$, $p<0.001$), and children with diplegic CP had significantly higher scores of these four measures than those with quadriplegic CP did. Further, the scores differed significantly between those with moderate and severe CP. In the analysis, according to the GMFM, WeeFIM, ICF Function, and ICF Activity and Participation, mild CP (MACS I) is a significant difference than moderate CP (MACS II, III) and severe CP (MACS IV, V), moderate CP (MACS II, III) is a significant difference than severe CP (MACS IV, V) (Table 1). The score of the ICF component of Activity and Participation showed a significant, strong correlation with the scores of GMFM ($r=-0.737$, $p<0.01$), GMFCS ($r=0.711$, $p<0.01$), MACS ($r=0.699$, $p<0.01$), WeeFIM ($r=-0.838$, $p<0.01$), and ICF Function ($r=0.882$, $p<0.01$) (Table 2).

Table 1. The main difference of variables according to the general characteristics (N=77)

	Variables	GMFM	WeeFIM	ICF sub-item Function	ICF sub-item activity and participation
Paralyzed types	Quadriplegia (n=11), a	29.3 (14.9)	36.0 (8.8)	36.9 (15.3)	88.4 (29.2)
	Diplegia (n=56), b	74.6 (17.6)	91.8 (28.7)	24.8 (15.5)	42.3 (38.5)
	Hemiplegia (n=10), c	95.0 (4.9)**, [†]	105.2 (21.0)**, [†]	18.2 (9.6)*, [†]	21.6 (17.5)**, [†]
GMFCS	Mild (n=20), a	96.9 (2.0)**, [§]	119.1 (8.9)**, [§]	12.3 (10.1)**, [§]	12.6 (14.1)**, [§]
	Moderate (n=44), b	69.9 (14.9)	84.0 (26.2)	28.5 (13.7)	50.2 (37.5)
	Severe (n=13), c	33.4 (17.0)	39.4 (11.5)	36.6 (15.6)	84.3 (32.4)
MACS	Mild (n=20), a	94.3 (6.3)**, [§]	120.4 (6.6)**, [§]	11.9 (9.3) **, [§]	11.4 (12.8)**, [§]
	Moderate (n=50), b	67.7 (18.7)	78.5 (27.8)	28.4 (13.9)	52.9 (36.9)
	Severe (n=7), c	25.4 (13.8)	36.4 (10.1)	45.3 (8.9)	97.9 (25.6)

M (SD); *p<0.05, **p<0.001 means a significant difference between groups; § mean that 'a' is a significant difference than 'b, c' and 'b' is a significant difference than 'c' (a>b>c); [†] mean that 'c' is a significant difference than 'a, b' and 'b' is a significant difference than 'a' (c>b>a)

Table 2. The correlation among GMFM, GMFCS, MACS, WeeFIM, ICF function, and ICF activities and participations (N=77)

	GMFM	GMFCS	MACS	WeeFIM	ICF function	ICF activities and participations
GMFM	1					
GMFCS	-0.933**	1				
MACS	-0.824**	0.835**	1			
WeeFIM	0.810**	-0.834**	-0.828**	1		
ICF function	-0.680**	0.642**	0.715**	-0.737**	1	
ICF activities and participations	-0.737**	0.711**	0.699**	-0.838**	0.882**	1

**p<0.01

DISCUSSION

This study investigated the relationships among the scores of the GMFM, GMFCS, MACS, and WeeFIM and the ICF-CY components of Function and Activity and Participation with the aim of guiding intervention plans and treatment strategies and helping to improve activity performance and community participation among children with spastic CP. As a movement disorder, CP leads to restrictions in the ability to perform physical activity and to gain experience with exercise. In addition, CP causes delays to the development of sensory or perceptual function, the formation of movement concept, and social development. Thus, in the long term, CP not only produces movement disorders but restricts participation in several activities¹⁰. It is well recognized that participation and activity restrictions vary with the extent of disability⁸.

This study involved children with the spastic type of CP. The different types of this movement disorder are considered to have a major impact on body function, activity performance, and community participation. Post-hoc analysis of our results indicated that children with hemiplegic CP had higher scores of the GMFM, WeeFIM, and Function and Activity and Participation components of the ICF-CY than those with diplegic and quadriplegic CP. This finding indicates that hemiplegic CP allows for higher body function, performance of more activities, and greater participation in school and society than diplegic and quadriplegic CP. The functionality of patients is poorer in the order hemiplegia, diplegia, and quadriplegia; the more severe the disability their mobility decreased¹⁵ and better the mobility, better their activity and participation. However, functionality in CP is considerably affected by cognition, which is thought to affect participation and activity performance, because of which the percentage of children with good cognition and perception who enter normal schools is higher than the percentage of children with poor cognition and perception. This interaction with normal children stimulates the physical mobility of children with CP, thereby improving their activity performance and participation.

GMFCS is a 5 level clinical classification system that describes the gross motor function of people with cerebral palsy on the basis of self-initiated movement abilities. In this study, CP with mobility levels of GMFCS level I was classified as mild; GMFCS levels II and III, as moderate; and GMFCS levels IV and V, as severe. Significant differences were observed among the GMFM, WeeFIM, ICF Function and ICF Activity and Participation in the order of mild, moderate, and severe. Post-hoc analysis of our results indicated that the GMFM, WeeFIM, ICF Function, and ICF Activity and Participation, mild CP (GMFCS I) is a significant difference than moderate CP (GMFCS II, III) and severe CP (GMFCS IV, V), moderate CP

(GMFCS II, III) is a significant difference than severe CP (GMFCS IV, V).

The MACS describes how children with CP use their hands to handle objects in daily activities. MACS is designed to highlight the importance of hand function for independences in daily life. Even in terms of the MACS, children with MACS level I showed better function than those with MACS levels II–V and in the difference GMFM, WeeFIM, ICF Function and ICF Activity and Participation showed results in the order of mild, moderate, and severe. Post-hoc analysis of the results indicated that the GMFM, WeeFIM, ICF Function, and ICF Activity and Participation scores, mild CP (MACS I) is a significant difference than moderate CP (MACS II, III) and severe CP (MACS IV, V), moderate CP (MACS II, III) is a significant difference than severe CP (MACS IV, V). The findings of Beckung's study¹⁶⁾ on the correlations between children's activity limitations and participation levels showed that children with CP of GMFCS and bimanual fine motor function levels I and II showed less participation limitations than those with CP of levels III–V and are thus in direct agreement with our findings. The more severe the CP, the greater are the GMFCS and MACS levels, and children with severe CP require help from their guardians or other auxiliary tools to perform activities. It is likely that they will be severely limited in terms of their participation in society and school because of their inability to freely use their body and limbs.

In this study, the ICF Function score showed a significant, strong correlation with the scores of GMFM, GMFCS, MACS, WeeFIM, and ICF Activity and Participation. Similarly, the ICF Activity and Participation score showed a significant, strong correlation with the scores of GMFM, GMFCS, MACS, WeeFIM, and ICF Function. Children with CP who have good function as determined from the GMFM, GMFCS, and MACS scores show a tendency toward better functional movement and therefore may be able to effectively participate in school and daily activities. Further, children's functional levels, which depend on their disability levels, show a correlation with their extent of participation in society, school, and their homes, and a study by Arnaud¹⁷⁾ suggests that physical activity has a close relationship with not only social activity but also social functionality.

During elementary education, children with CP showed a significant correlation between their main cause of function and their activity and participation, suggesting that the better their physical function, the better they will be able to enforce their will over active functions, which will in turn have a positive effect on their activity and participation. The extent of physical movement among children with CP is a crucial factor affecting their quality of life⁶⁾, and depending on the extent of their disability, their level of participation in everyday life varies by a considerable margin¹⁸⁾.

In sum, although differences in children's physical and athletic abilities affect their participation in school and social life, their activity and participation levels can be hypnotized to improved if their functionality is stimulated during motor functionality development. Thus, during clinical treatment, therapists should not only stimulate the physical functionality of children with CP but work to improve their participation and activity performance by educating parents and guardians and by using physical assistance implements. Understanding the factors that affect the participation of children with CP in school and the community is vital for their rehabilitation and should be an important consideration while planning rehabilitation programs for such children, during which not only motor functionality and development but also the functional causes that restrict engagement in activities and participation need to be a focus. This will enable the design of an effective treatment plan that monitors the child's physical level and contribute to research on better rehabilitation for affected individuals.

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