



Exploring the Relationship Between International Classification of Functioning, Disability, and Health Items Linked to Clinical Assessments in Children With Cerebral Palsy

Sang-Duk Park¹, MS, Sook-Hee Yi², MD, Jeong-Soo Kim^{1,3}, PhD

¹Department of Physical Therapy, Seoul Rehabilitation Hospital, ²Department of Rehabilitation Medicine, Seoul Rehabilitation Hospital, Seoul, ³Department of Physical Therapy, College of Health Science, Yonsei University, Wonju, Korea

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Corresponding Author

Jeong-Soo Kim

E-mail: suah7475@hanmail.net

<https://orcid.org/0000-0001-9994-9360>

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Background: The International Classification of Functioning, Disability, and Health-Child and Youth version (ICF-CY) is designed to record the characteristics of developing children and examine the influence of a child's environment on their health.

Objects: This study was designed to determine the relationship between the clinically extracted ICF-CY items and The Pediatric Evaluation of Disability Inventory (PEDI) and Gross Motor Function Measure (GMFM) items.

Methods: Thirty patients (17 males and 13 females) who were hospitalized in a pediatric and youth patient unit of a rehabilitation hospital were included in the study. Four health professionals (two physical therapists and two occupational therapists) working independently linked the PEDI and GMFM-66 items to the activity and participation domains of the ICF-CY.

Results: There were strong negative correlations between the ICF-CY subdomains and the PEDI subdomains ($r = 0.76-0.95$; $p < 0.05$). There were positive strong correlations between the ICF-CY subdomains and the GMFM-66 ($r = 0.76-0.95$; $p < 0.05$).

Conclusion: The extracted ICF codes were a valid tool for evaluating the mobility and self-care conditions of cerebral palsy in the pediatric rehabilitation area.

INTRODUCTION

The World Health Organization (WHO) announced the International Classification of Functioning, Disability, and Health (ICF) by presenting a common language and framework that referred to health and health-related states in terms of body function and body structure, activity, and participation [1]. The International Classification of Functioning, Disability, and Health-Child and Youth version (ICF-CY) is an extended version of the ICF and special attention is given to the aspects of behavior, learning, and development of children and youth [2]. The ICF-CY can be used as a framework for human functioning and disability, which are considered a result of the dynamic interaction between health conditions and contextual factors.

The ICF-CY framework can be used as a common reference to compare the content of clinical outcome measures [3]. Mapping clinical outcome measurements to the ICF-CY coding

system can provide information on health areas, disabilities, and functions applied by these measurements. In the field of rehabilitation for children with disabilities, comprehensive communication between team members and the use of common terminology according to the personal conditions, health condition and environmental factors are essential [4].

The Pediatric Evaluation of Disability Inventory (PEDI) is a widely used clinical assessment that samples the key functional capabilities and performance of children between the ages of 6 months and 7.5 years [5]. The PEDI was designed to assess what the child actually does in the activity rather than describe his or her impairments (body functions and body systems). The functional skills section of the PEDI provides summary scores that reflect the child's current repertoire of daily life skills in each of three domains (self-care, mobility, and social function), while the caregiver assistance section provides a summary scores of the extent to which the child's total perfor-



mance of complex daily life tasks such as dressing or moving around is supported by help from a caregiver. The Gross Motor Function Measure (GMFM) was used to assess the subjects' gross motor function. This measure comprises five dimensions of (A) lying and rolling, (B) sitting, (C) crawling and kneeling, (D) standing, and (E) walking, running, and jumping [6].

The ICF-CY is actually used in clinical practice, but there is a lack of research on whether it fully reflects the evaluation tools used by clinical experts in each specialized field. Therefore, it is importance to find out whether ICF-CY items reflect the contents of representative functional evaluation tools in physical and occupational treatment areas such as PEDI and GMFM.

Children with cerebral palsy (CP) are certainly limited in their daily activities and capacity to participate [7]. Their condition not only restricts their social participation but also their overall quality of life [8]. The activity and participation of affected children vary depending upon the severity of their condition, age, self-management, and movement and function in society [9]. Thus, 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 ICF-CY sets are essential in providing a practical way to address a specific patient population in daily practice. The ICF-CY and PEDI are grounded in a similar conceptual model. However, there is a lack of research on how the assessment tools used by clinical professionals in each specialty compare to the ICF-CY framework. The aim of this study was to develop standardized ICF-CY sets linked to specific chapters of the PEDI and Gross Motor Function Measure (GMFM).

MATERIALS AND METHODS

1. Participants

Thirty patients (17 males and 13 females) who were hospitalized in a pediatric and youth patient unit of rehabilitation hospital were included in our study. The inclusion criteria were a diagnosis of uni- or bilateral, dyskinetic CP, those who were classified at Gross Motor Function Classification System (GMFCS) levels I-IV, and patients under 18 years of age. The study was approved by the Seoul Rehabilitation Hospital Institutional Review Board (No. SRH2013R-01). Table 1 lists the general characteristics of the participants.

2. Procedure

Four health professionals (two physical therapists and two occupational therapists) working independently linked the PEDI and GMFM-66 items to the activity and participation domains of the ICF-CY using the same coding process described in a pre-meeting and then resolved disagreements by consensus. The two physical therapists and two occupational therapists had more than five years of clinical experience and wide knowledge and training in the ICF-CY model. A total of five consensus meetings were held to reach an agreement about the connections between the ICF-CY codes and items. The linking process followed the linking rules proposed by Cieza et al. [10], which involved linking the meaningful concept associated with each of the PEDI and GMFM-66 items to the ICF-CY codes by a manifest and deductive content analysis procedure. A meaningful concept was described as a set of words with one key meaning identified. If an item contained more than one concept, each concept was linked separately.

The PEDI and GMFM-66 were performed by two researchers before and after a 12-week treatment session. Treatment was carried out in everyday situations three times a week at the rehabilitation hospital. The authors did not participate in treating the children.

The PEDI is a standardized tool using parental reports through structured interviews and consists of the Functional Skills Scale (FSS), and the Caregiver Assistance Scale (CAS), both consisting of three domains of self-care, mobility, and social function. For the present study, the self-care and mobil-

Table 1. Descriptive data of all subjects (N = 30)

Variables	Categories	n
Sex	Male	17
	Female	13
Age (yr)		5.4 ± 4.4 [1-18]
Classification of CP	Spastic bilateral	16
	Spastic unilateral	7
	Dyskinetic	7
GMFCS level	1	3
	2	8
	3	6
	4	7
	5	6
MACS level	1	0
	2	6
	3	7
	4	9
	5	8

CP, cerebral palsy; GMFCS, Gross Motor Function Classification System; MACS, the Manual Ability Classification System.

ity domains were used. The PEDI-FSS measures what the child can do in her/his everyday environment (capability) and each question is scored as 0, indicating “cannot do” and 1, indicating “can do.” The CAS catch what the child actually does in her/his everyday environment (performance). The scores depend upon the extent of the caregiver’s help, with 0 indicating full dependence and 5 indicating independence.

The GMFM-66 is an abbreviated version of the GMFM, which is a standardized tool developed to measure the gross motor function in children with CP in a specific test situation, without the use of mobility aids or orthoses. The GMFM-66 consists of 88 items grouped into five dimensions of gross motor function including lying and rolling, sitting, crawling and kneeling, standing, and walking, running, and jumping.

3. Statistical Analysis

The SPSS 23 (SPSS Statistics for Windows, Version 23.0; IBM Corporation, Armonk, NY, USA) program was used for demographic data and correlation analysis. The pre and post-treatment differences were analyzed with the paired t-test. Correlations between the extracted ICF-CY code set and PEDI and the GMFM-66 subdomain scores were analyzed with Pearson’s correlation coefficient ($r = 0.10$ – 0.29 was weak, $r = 0.30$ – 0.49 was moderate, and $r \geq 0.50$ was a strong correlation [11]).

RESULTS

The study was completed with 30 (17 males and 13 females) children with CP. The demographic characteristics such as CP classification, GMFCS level, and the Manual Ability Classification System (MACS) level are given in Table 1. The mean age of the children with CP was 5.4 ± 4.4 years. As shown in Table 1, 16 subjects had spastic bilateral type CP, seven had the spastic unilateral type, and seven had the dyskinetic type. The GMFCS level of three subjects was 1, eight subjects had a level of 2, six subjects had a level of 3, seven subjects had a level of 4, and six subjects had a level of 5. The MACS level of six subjects was 2, seven subjects had a level of 3, nine subjects had a level of 4, and eight subjects had a level of 5.

Tables 2–4 give a summary of the coding related to the ICF codes with clinical assessments. Most of the requested functions in the GMFM-66 were classified in the activity component of the ICF, but most of the PEDI functions were classified in both the activity and participation components of the ICF.

Table 2. Extracted ICF-CY codes linked to the GMFM-66

List of codes	Category names
d4100	Lying down
d4101	Squatting
d4103	Sitting
d4104	Standing
d4105	Bending
d4106	Shifting the body’s center of gravity
d4107	Rolling over
d4150	Maintaining a lying position
d4153	Maintaining a sitting position
d4154	Maintaining a standing position
d4155	Maintaining head position
d4200	Transferring oneself while sitting
d4351	Kicking
d4500	Walking short distances
d4502	Walking on different surfaces
d4550	Crawling
d4551	Climbing
d4552	Running
d4553	Jumping

ICF-CY, The International Classification of Functioning, Disability, and Health-Child and Youth version; GMFM-66, Gross Motor Function Measure-66.

The GMFM-66 coded 19 items in the mobility domain of the ICF. PEDI mobility and mobility assist were coded in 29 items and 13 items respectively in the mobility domain of the ICF. In addition, the self-care function of the PEDI was coded in 13 items and self-care assist was coded in 13 items.

The correlation between the extracted ICF-CY codes and the PEDI subdomain and the GMFM-66 was found to be strongly acceptable. There were strong negative correlations between the extracted ICF-CY codes and the PEDI scores ($r = 0.76$ – 0.95 ; $p < 0.05$). There were strong positive correlations between the extracted ICF-CY codes and the GMFM-66 scores ($r = 0.76$ – 0.95 ; $p < 0.05$) (Table 5).

DISCUSSION

The main findings in the present study revealed that the extracted ICF-CY codes showed a high correlation with the GMFM-66 and PEDI. Therefore, it can be useful in evaluating the functional conditions of patients with CP in relation to mobility and self-care in the pediatric rehabilitation area. To the best of our knowledge, no previous study investigated the validity of the ICF-CY codes extracted by clinical matching, making this study the first in this respect.

In our study, ICF-CY and clinical evaluation charts show a negative correlation. The reason is that ICF-CY means a lower

Table 3. Extracted ICF-CY codes linked to the PEDI mobility function

PEDI mobility function		PEDI mobility assist	
List of codes	Category names	List of codes	Category names
d4100	Lying down	d4101	Squatting
d4101	Squatting	d4102	Kneeling
d4102	Kneeling	d4103	Sitting
d4103	Sitting	d4104	Standing
d4104	Standing	d4105	Bending
d4105	Bending	d4106	Shifting the body's center of gravity
d4106	Shifting the body's center of gravity	d4107	Rolling over
d4107	Rolling over	d420	Transferring oneself while sitting
d420	Transferring oneself while sitting	d4551	Climbing
d430	Lifting	d4556	Shuffling
d4450	Pulling	d4600	Moving around within the home
d4451	Pushing	d4601	Moving around within buildings other than home
d4452	Reaching	d4602	Moving around outside the home and other buildings
d4453	Turning or twisting the hands or arms		
d4454	Throwing		
d4455	Catching		
d4500	Walking short distances		
d4502	Walking on different surfaces		
d4503	Walking around obstacles		
d4550	Crawling		
d4551	Climbing		
d4552	Running		
d4553	Jumping		
d4555	Scotting and rolling		
d4556	Shuffling		
d4600	Moving around within the home		
d4601	Moving around within buildings other than home		
d4602	Moving around outside the home and other buildings		
d465	Moving around using equipment		

ICF-CY, International Classification of Functioning, Disability, and Health-Child and Youth version; PEDI, Pediatric Evaluation of Disability Inventory.

Table 4. Extracted ICF-CY codes linked to the PEDI self-care function

PEDI self-care function		PEDI self-care assist	
List of codes	Category names	List of codes	Category names
d510	Washing oneself	d510	Washing oneself
d5200	Caring for skin	d5200	Caring for skin
d5201	Caring for teeth	d5201	Caring for teeth
d5202	Caring for hair	d5202	Caring for hair
d5205	Caring for nose	d5205	Caring for nose
d5300	Regulating urination	d5300	Regulating urination
d5301	Regulating defecation	d5301	Regulating defecation
d5400	Putting on clothes	d5400	Putting on clothes
d5401	Taking off clothes	d5401	Taking off clothes
d5402	Putting on footwear	d5402	Putting on footwear
d5403	Taking off footwear	d5403	Taking off footwear
d550	Eating	d550	Eating
d560	Drinking	d560	Drinking

ICF-CY, International Classification of Functioning, Disability, and Health-Child and Youth version; PEDI, Pediatric Evaluation of Disability Inventory.

functional level as the score increases, but GMFM66 and PEDI mean a higher functional level as the score increases. In the extracted ICF-CY codes, the body structure components were not revealed as it was rarely covered by clinical measures just

like the GMFM-66 and PEDI. The extracted GMFM-66 and PEDI content differed significantly in their representation of the ICF-CY codes. In the component of activity and participation, the GMFM only covered subdomain d4 (mobility)

Table 5. Correlation between extracted ICF-CY codes and PEDI and GMFM-66 scores

		Pre		Post	
		r	p	r	p
ICF-CY mobility	GMFM-66	0.89	0.01	-0.95	0.01
	PEDI mobility function	-0.92	0.01	-0.95	0.01
	PEDI mobility assist	-0.76	0.01	-0.83	0.01
ICF-CY self-care	PEDI self-care function	-0.95	0.01	-0.93	0.01
	PEDI self-care assist	-0.93	0.01	-0.80	0.01

ICF-CY, International Classification of Functioning, Disability, and Health-Children and Youth version; GMFM-66, Gross Motor Function Measure-66; PEDI, Pediatric Evaluation of Disability Inventory.

compared to the PEDI, which included d4 (mobility) and d5 (self-care). Another study showed that PEDI included additional b1 (mental functions) and e1 (products and technology) subdomains [12]. We excluded the social functional area of the PEDI because it included too many items. The GMFM was highly recommended by health professionals as the first choice and the gold standard tool for assessing gross motor function in children with CP [13]. In our study, the GMFM-66 mapped to the components of the activity area. PEDI and GMFM-66 primarily cover only the components of activity and participation. These findings suggest a lack of good representation of the important interactions between the child's personal characteristics and the environment. However, our study provides novel information on how to characterize each measure based on the ICF language.

The selection of a proper outcome measure depends upon many factors including the psychometric properties and instrument's content, the type of intervention and its effect, and the availability of a version for the child's specific age [14]. In our study, the GMFM-66 and PEDI were highly associated with the extracted ICF-CY codes at the pre and post-treatment times. However, there was no significant correlation in the amount of change over time. This finding implies that ICF-CY code extraction is a meaningful evaluation tool limited to use as a cross-sectional score in the mobility and self-care areas.

The ICF-CY contains many areas that the GMFM and PEDI do not. However, such broadness makes the clinical application more difficult [15]. In addition, some ICF-CY categories were not specific enough to fully represent the unique content of some items of the GMFM and PEDI. But there are various benefits of the ICF-CY in the pediatric rehabilitation area. First, it contains domains that are important for describing functional mobility and its environments. Therefore, it can be applied across different parts of management such as assess-

ment, goal-setting, and the outcome measures of intervention. Secondly, the ICF-CY may enhance communication among professionals, and among professionals and parents because it offers a common inter-professional language. Therefore, identifying the ICF domains related to the GMFM and PEDI is preparatory work necessary for the clinical application of the ICF-CY.

A limitation of our study was that the ICF codes extracted from the PEDI only included the mobility and self-care chapters. However, the PEDI included additional mental functions and products and technology subdomains and did not reflect the all domain of the PEDI. Additionally, the total sample size of our study was 30. Therefore, a separate analysis by age groups such as preschool, school, and adolescents could not be done. Future studies should be performed with more samples including the separate analysis and clinical assessment of additional areas.

CONCLUSIONS

The present study revealed that the extracted ICF codes showed a high correlation with clinical assessments such as the GMFM-66 and PEDI. The extracted ICF codes were a valid tool for evaluating the mobility and self-care conditions of CP in the pediatric rehabilitation area. Further studies that consider more variables such as mental and environmental factors and social support for children and their families are needed.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

Conceptualization: JSK, SDP, SHY. Data curation: SDP. Formal analysis: JSK, SDP. Investigation: JSK, SDP. Methodology: JSK. Project administration: SDP. Resources: JSK. Visualization: JSK. Writing - original draft: JSK. Writing - review & editing: JSK, SDP, SHY.

ORCID

Sang-Duk Park, <https://orcid.org/0000-0002-1510-5118>

Sook-Hee Yi, <https://orcid.org/0000-0003-2996-3284>

REFERENCES

- Lollar DJ, Simeonsson RJ. Diagnosis to function: classification for children and youths. *J Dev Behav Pediatr* 2005;26(4):323-30.
- World Health Organization. International classification of functioning, disability and health: children and youth version: ICF-CY. Geneva: World Health Organization; 2007.
- Escorpizo R, Finger ME, Glassel A, Gradinger F, Lückenemper M, Cieza A. A systematic review of functioning in vocational rehabilitation using the international classification of functioning, disability and health. *J Occup Rehabil* 2011; 21(2):134-46.
- Sheehan D, Robertson L, Ormond T. Comparison of language used and patterns of communication in interprofessional and multidisciplinary teams. *J Interprof Care* 2007;21(1):17-30.
- Haley SM. Pediatric evaluation of disability inventory (PEDI): development, standardization and administration manual. Boston: PEDI Research Group, New England Medical Center Hospital; 1992.
- Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Dev Med Child Neurol* 1997;39(4):214-23.
- Smits DW, Ketelaar M, Gorter JW, van Schie P, Dallmeijer A, Jongmans M, et al. Development of daily activities in school-age children with cerebral palsy. *Res Dev Disabil* 2011;32(1): 222-34.
- Davis E, Waters E, Mackinnon A, Reddihough D, Graham HK, Mehmet-Radji O, et al. Paediatric quality of life instruments: a review of the impact of the conceptual framework on outcomes. *Dev Med Child Neurol* 2006;48(4):311-8.
- Ostensjø S, Carlberg EB, Vøllestad NK. Everyday functioning in young children with cerebral palsy: functional skills, caregiver assistance, and modifications of the environment. *Dev Med Child Neurol* 2003;45(9):603-12.
- Cieza A, Geyh S, Chatterji S, Kostanjsek N, Ustün B, Stucki G. ICF linking rules: an update based on lessons learned. *J Rehabil Med* 2005;37(4):212-8.
- Khetani MA, Cliff AB, Schelly C, Daunhauer L, Anaby D. Decisional support algorithm for collaborative care planning using the participation and environment measure for children and youth (PEM-CY): a mixed methods study. *Phys Occup Ther Pediatr* 2015;35(3):231-52.
- Schiariti V, Klassen AF, Cieza A, Sauve K, O'Donnell M, Armstrong R, et al. Comparing contents of outcome measures in cerebral palsy using the international classification of functioning (ICF-CY): a systematic review. *Eur J Paediatr Neurol* 2014;18(1):1-12.
- Vargus-Adams JN, Martin LK. Measuring what matters in cerebral palsy: a breadth of important domains and outcome measures. *Arch Phys Med Rehabil* 2009;90(12):2089-95.
- Palisano RJ, Orlin M, Chiarello LA, Oeffinger D, Polansky M, Maggs J, et al. Determinants of intensity of participation in leisure and recreational activities by youth with cerebral palsy. *Arch Phys Med Rehabil* 2011;92(9):1468-76.
- Bickenbach J, Cieza A, Rauch A, Stucki G. ICF core sets: manual for clinical practice. Göttingen: Hogrefe; 2012.