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Psychometric Properties of the WeeFIM in Korean Children With Cerebral Palsy

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Abstract

The WeeFIM is an outcome measure used worldwide to evaluate the functional abilities of children. The aim of this study was to evaluate the psychometric properties of WeeFIM in Korean children with cerebral palsy (CP) using the Rasch model. The mean age of the participants (92 boys and 53 girls) was 10.6 years (SD=2.3, range 5~15 years). The Winsteps software was used for analyzing the internal construct validity and reliability of WeeFIM. For analyzing the internal validity the motor and cognitive area items of the WeeFIM were analyzed both together and separately. When all 18 items were analyzed, 4 were considered to be misfits; upper extremity dressing, lower extremity dressing, toileting, and comprehension. When only the 13 motor items were analyzed, toileting, bladder management, and bowel management were considered misfits. In addition, only comprehension was considered as a misfit among the 5 cognitive items. The most difficult motor items were stair climbing, and bathing. The simple ones were eating, bowel management, and bladder management. The most difficult cognitive item was problem solving, and the simplest one was comprehension. The person separation indexes and reliability for combined and divided instruments were reported as excellent. These results demonstrated the applicability of WeeFIM to Korean CP children with satisfactory reliability and validity. Further studies should include young children with CP and compare item difficulty among the different types of CP. In addition, the Korean normative data of nondisabled children should be used to compare the cultural differences between Korea and other countries.

Key Words: Cerebral palsy; Rasch analysis; WeeFIM.

Introduction

In the field of pediatric rehabilitation, it is important to monitor progress in growth and assess the sensori-motor function. Cerebral palsy is a group of disorders related to growth, the development of postural control and motor skills. Various outcome measures have been developed and used to assess these disorders. Among these, the Functional Independence Measure for Children (WeeFIM) and the Pediatric Evaluation of Disability Inventory (PEDI) are the most popular and commonly used instruments for measuring the functional ability of children with CP (Ottenbacher et al, 2000; Ziviani et al, 2001). This is because these instruments can adequately assess a child's level of independence in activities and participation in daily living (Tur et al, 2009).

The WeeFIM is an adapted version of the Functional Independence Measure (FIM) for adults, which measures the severity of disability and changes in the functional activities of daily living. The WeeFIM is an 18-item, 7-scaled instrument. Originally the items are divided into 6 domains (self-care, sphincter control, transfer, locomotion, communication, and social cognition), and can be further organized into 2 subscales: the motor subscale (13 items, covering the domains of self-care, sphincter control, transfer, and locomotion) and the cognitive subscale (5 items, covering the domains of communication, and social cognition) (Finch et al, 2002).

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Since its development in 1987, several studies have evaluated the reliability and validity of this instrument in both non-disabled and disabled children (Liu et al, 1998; Yung et al, 1999). Msall et al (1994) evaluated normative WeeFIM data from 6-month to 7-year-old nondisabled children in North America. Ottenbacher et al (1999) distinguished between disability group and normal group using the WeeFIM instrument. Liu et al (1998) and Tsuji and colleagues (1999) demonstrated the reliability, validity, and difficulty order of the WeeFIM in nondisabled Japanese children. In China, Wong et al (2002) created a normative functional independence profile for children in Hong Kong by adapting the American-based WeeFIM. In Turkey, Aybay et al (2007) validated the Turkish translation of the WeeFIM instrument for nondisabled children in Turky.

Although the WeeFIM has been considered as one of the validated functional assessment scales for children widely, a few studies in Korea have used it for the evaluation of the activities of daily living (ADL). The validity of the WeeFIM was not examined in Korea. In addition, there are insufficient studies regarding the psychometric properties for the group of disabled children. The objective of this study was to adapt the WeeFIM to the Korean children with CP and investigate the psychometric properties using Rasch analysis.

Methods

Subjects

This study was performed on children with CP in the age range 5∼15 years, with mean age of 10.6 years (SD=2.3). Table 1 presents the detailed charac-

Table 1. Characteristics of children with cerebral palsy (N=145)

Characteristic		Value	%
Gender	Girls	92	63.0
	Boys	53	36.3
	Missing data	1	.7
Types of CP by Swedish classification system	Quadriplegia	55	37.9
	Triplegia	6	4.1
	Diplegia	61	42.1
	Hemiplegia	20	13.8
	Missing data	3	2.1
Types of CP by Surveillance of CP in Europe	Spastic	114	78.6
	Athetoid	20	13.8
	Dystonic	4	2.8
	Ataxic	7	4.8
Co-morbidity conditions	Hearing problems	0	.0
	Vision problems	35	24.1
	Speech disorders	61	42.1
	Seizures, epilepsy	27	18.6
GMFCS level	Level 1	28	19.3
	Level 2	20	13.8
	Level 3	21	14.5
	Level 4	10	6.9
	Level 5	66	45.5

teristics and co-morbidities of these children. Informed consent for participation was obtained from either the subjects or the parents.

A total of 145 children, 92 boys and 53 girls, participated in this study. Their mean weight was 27.3 ㎏ (SD=12.8) and mean height was 126.0 ㎝ (SD=15.9). The topographical distributions according to the Swedish classification system, fell into 4 categories: quadriplegia (n=55), triplegia (n=6), diplegia (n=61), and hemiplegia (n=20). In terms of types of CP, as delineated by the Surveillance of CP in Europe, 114 (78.6%) had the spastic type, 20 (13.8%) the athetoid type, 4 (2.8%) the dystonic type, and 7 (4.8%) the ataxic type. The clinical characteristics were defined according to motor function, as measured by the Gross Motor Function Classification System (GMFCS). The highest level of GMFCS was 28 (19.3%) and the lowest was 66 (45.5%).

Instrument

The 18 items of the original WeeFIM are allocated into 6 subscales: self-care, sphincter control, transfer, locomotion, communication, and social cognition (Jongjit et al, 2006; Uniform Data System for Medical Rehabilitation, 1998). Recently, these items were separated into motor and cognitive areas items (Chen et al, 2005; Tur et al, 2009; Yung et al, 1999). The 13 motor items were included in 4 subscales: self-care (eating, dressing, bathing, dressing of upper body, dressing of lower body, and toileting); sphincter control (bladder management and bowel management); transfer (chair/wheelchair, toilet, and tub/shower); and locomotion (walk/wheelchair/crawl and stairs). The 5 cognitive items were included in 2 subscales: communication (comprehension and expression); and social cognition (social interaction, problem solving, and memory).

Each item was scored from 1 to 7. A score is 1 rated when the task is completed with full dependence on aid, while 7 is rated to accomplished tasks performed with total independence. The overall score ranges from a minimum of 18 (totally dependent) to a maximum of 126 (totally independent) (Aybay, et al, 2007; Gunel et al, 2009; Ottenbacher et al, 1997).

Statistical Analysis

We performed Rasch analysis using Winsteps (Winsteps, Chicago, IL, USA) version 3.67.0. For analysing the internal construct validity infit mean square fit statistics (MNSQ) was used (Bond and Fox, 2007), because infit MNSQ is more sensitive than outfit MNSQ to unexpected behavior affecting response to items near the person's ability level (Wright and Master, 1982). In Rasch analysis, the reliability of the instrument is estimated in terms of separation reliability. A separation index of 2.00 is considered good reliability (a 2.00 separation index is interpreted as Cronbach's α =.8), and a separation index of 3.00 is considered excellent (Cronbach's α=.9) (Duncan et al, 2003).

Results

For analyzing the internal validity the motor and cognitive area items of the WeeFIM were analyzed both together and separately. When all 18 items were analyzed, 4 were considered to misfits: upper extremity dressing, lower extremity dressing, toileting, and comprehension. When only the 13 motor items were analyzed, toileting, bladder management, and bowel management were considered misfits. Only comprehension was considered to be a misfit among the 5 cognitive items (Table 2). Usually, the misfit items are removed from the instrument, but in this case, all of the items were intentionally retained for further analysis.

Figure 1 illustrates the motor and cognitive items hierarchically in terms of difficulty of order on the same linear continuum as person ability. The difficult motor items were stair climbing and bathing. The simple ones were eating, bowel management, and bladder management. The most difficult cognitive items the most difficult item was problem solving, and the simplest was comprehension.

In Table 3, the person separation indexes and reliability for combined and divided instruments are listed. The person separation index is an indication of how well the measurements separates the participants in this sample. The the person separation for all participants reliability was over .91.

Discussion

The WeeFIM has been considered to be a validated instrument for measuring the functional progress of various neurodevelopmental disorders, such as cerebral palsy, traumatic brain injury, and muscular dystrophy (Yung et al, 1999). Till date, there are no published studies on the its validity and reliability in Korea.

In this study, we performed Rasch analysis on the WeeFIM instrument and analyzed the fit statistics with all 18 items combined as well as the motor and cognitive items separately. Originally the WeeFIM instrument was developed as 18 items divided into 6 subscales (self-care, sphincter control, transfer, loco

Table 2. The WeeFIM item difficulties and infit statistics for combined and divided items

Items	Item difficulties (SE)				Infit MnSQ (Z)			
	Combined		Divided		Combined		Divided	
Motor items								
Eating	44.96	.80	40.45	.92	1.04	.4	1.27	1.7
Grooming	53.49	.79	51.68	.89	.77	-1.8	1.13	.9
Bathing	58.37	.82	57.81	.91	.77	-1.7	1.01	.1
Upper dressing	54.80	.79	53.35	.89	.53[a]	-4.1	.69	-2.4
Lower dressing	55.80	.80	54.70	.89	.60[a]	-3.3	.75	-1.9
Toileting	56.71	.81	55.75	.90	.54[a]	-3.9	.52[a]	-4.1
Bladder management	45.66	.79	41.38	.92	1.25	1.7	1.77[a]	4.3
Bowel management	44.90	.80	40.36	.92	1.29	1.9	1.76[a]	4.2
Bed/chair/wheel chair transfer	50.18	.78	47.39	.90	.90	-.7	.66	-2.6
Toilet transfer	52.94	.78	50.97	.89	1.00	.0	.76	-1.8
Tub/shower transfer	54.17	.79	52.55	.89	.87	-.9	.73	-2.0
Walk or wheelchair	49.03	.79	45.84	.90	1.07	.6	1.08	.6
Stairs climbing	58.37	.84	57.77	.93	1.37	2.3	1.30	1.9
Cognitive items								
Comprehension	37.85	.86	38.30	1.18	1.94[a]	5.0	1.58[a]	3.3
Expression	44.10	.81	50.10	1.12	1.19	1.3	1.14	1.0
Social interaction	44.42	.80	50.44	1.11	1.23	1.6	.84	-1.1
Problem solving	49.31	.78	59.90	1.11	1.31	2.1	.70	-2.3
Memory	44.86	.80	51.25	1.11	1.40	2.6	.96	-.3

MnSQ; mean square, [a]Misfit items; The resonable item mean square range is from .6 to 1.4.

Table 3. Separation statistics of non-extreme persons and items

	Standard error of mean	Persons	
		Separation index	Reliability
Combined	1.36	4.29	.95
Divided			
Motor	1.50	4.10	.94
Cognitive	2.28	3.26	.91

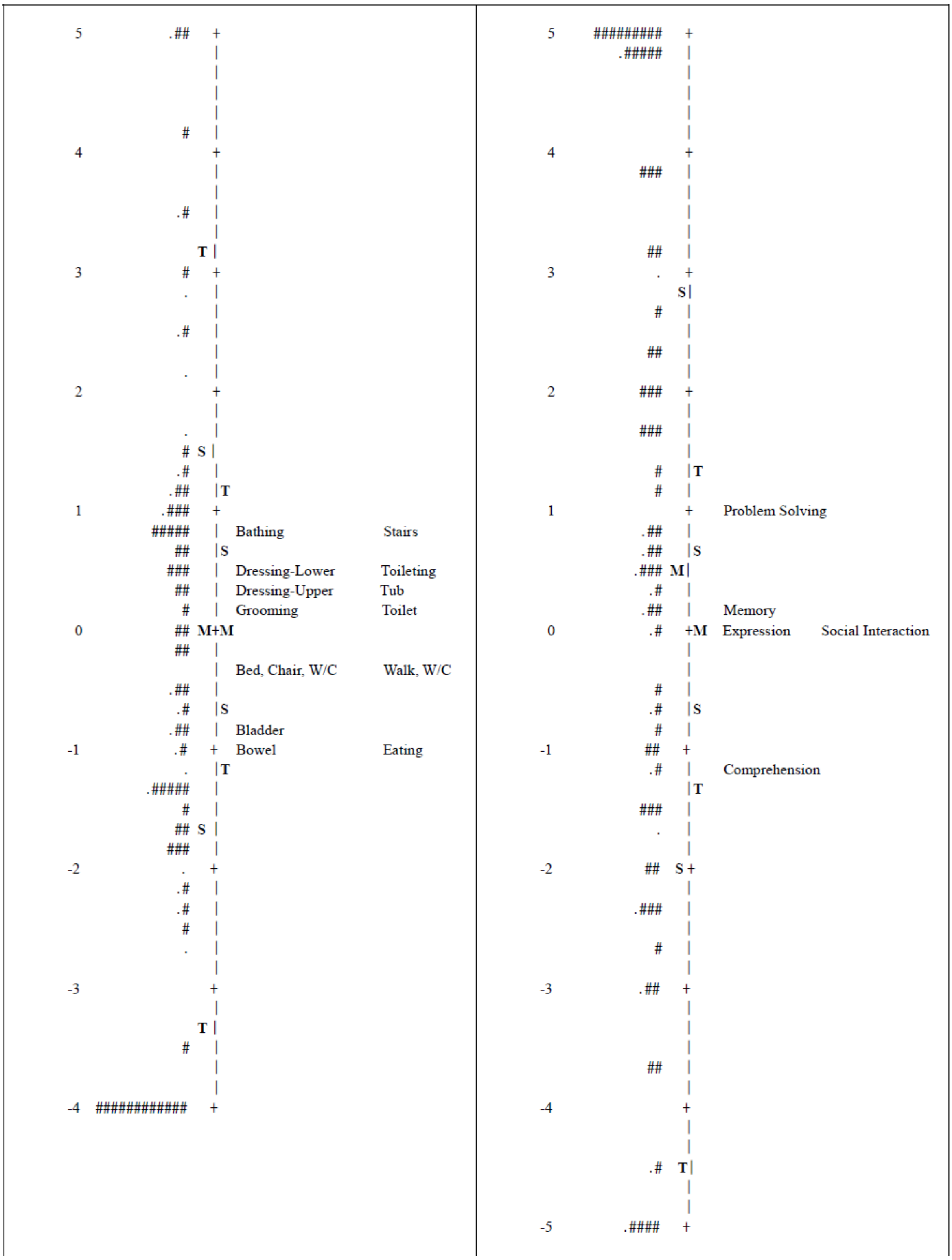

Figure 1. The WeeFIM item difficulties for motor (left) and cognitive (right) for Korean CP. Each '#' is 2.

motion, communication, and social cognition), but Chen et al (2005) and Aybay et al (2007) suggested that the subscale could also be divided into motor and cognitive subscales. Aybay and colleagues (2007) evaluated the internal validity of the WeeFIM instrument for non-disabled Turkish children. They found that the WeeFIM construct was divided into 2 subscales from a principal-component analysis of standardized residuals (Aybay et al, 2007). According to their results, the items stair climbing, eating, grooming, walking, and bathing could not be loaded any subscale, the remaining motor items were loaded to the first subscale, and all cognitive items were loaded to the second subscale.

As shown in Figure 1 and Table 2, the measure (logit) intervals between the simplest and the most difficult motor items for combined analysis were narrower than those for the divided one. This means that when the logit interval was more wider, the fine ADL changes could be described easily. As a result, when the motor and cognitive items were evaluated separately, the ADL changes could be described finely. According to the study of Tur et al (2009) on the validation of the WeeFIM in children with CP, the sphincter items must be removed in accordance with the Rasch model requirements. Our results were similar with those of previous studies. In motor subscles, toileting, bladder and bowel management were misfits items. This means that motor subsales could have multidimentionality and be divided into two dimension in children with CP. The factor structure of WeeFIM should be confirmed in children with CP.

The hierarchical order of motor and cognitive items is shown in Figure 1. Only some hierarchial arrangements and misfit items found in this study are similar to those of previous studies. In this study, bathing was the most difficult item, followed by stair climbing. According to the study of Chen and colleagues (2005), stair climbing was the most difficult, and bathing was the third most difficult item for disabled children. In Aybay et al (2007)'s study for nondisabled Turkish children, bathing item was the most difficult, and stair climbing was considered one of the simpler item. Among the 13 motor items, toileting, bladder management, and bowel management were considered misfits. The comprehension item's fit statistics were not acceptable in the 5 cognitive items in this study. The items eating, bladder management, tub/shower, and comprehension were considered misfits by Tsuji et al (1999). According to the study of Chen et al (2005), the items stair climbing, lower body dressing, walking, eating were determined to be misfits. These differences may be explained by the composition of the samples: our sample included only children with CP in the range of 5~15 years, whereas most studies recruited children below 8 years of age. The WeeFIM is validated to measure the performance of non-disabled children (6 months-8 years of age), children with developmental disabilities (6 months-12 years of age), and developmentally disabled individuals with a mental age of less than 7 years (Finch et al, 2002; Msall et al, 1994; Ottenbacher et al, 1999; Yung et al, 1999). This could be considered as one of the limitations of our study.

In Table 3, the person separation indexes and reliability for combined and divided instrument are reported as 4.29 (combined 18 items), 4.10 (divided, the 13 motor items), and 3.26 (divided, the 5 cognitive items). The person separation index represents how well the instrument separates the children in the sample. A person separation index of 3.0 represents an excellent level of separation, and 2.0 shows a good level (Duncan et al, 2003). The person separation reliability means an estimation of the replicability of person placement; all results demonstrated excellent reliability.

In this study, we performed Rasch analysis of the WeeFIM instrument, yielded interval measures for motor and cognitive subscales, and showed the internal construct validity and good reliability of WeeFIM. The item difficulty order of the WeeFIM in Korean children with CP was discussed. Arranging the motor and cognitive items hierarchically in terms of difficulty, helped the pediatric therapist working in CP rehabilitation centers to have a better idea of the training difficulties and aided better allocation of the resources available for rehabilitation. However, the item difficulty order in this study differed from that of other studies. The functional ability was influenced by age, the nature of impairment, and cultural differences, and the data in this study was obtained from Korean children with CP whose age ranged from 5 to 15 years. In future studies, it will be necessary to include young children with CP and compare the item difficulty among the different CP types. In addition, the Korean normative data of non-disabled children should be used to compare the cultural differences between Korea and other countries.

Conclusion

Rasch analysis of the WeeFIM for children with CP has been shown to incorporated 2 subscales, 1 for motor items and the other for cognitive items. The most difficult motor item was stairs climbing, whereas the simplest was eating. The most difficult cognitive item was problem solving and the simplest was comprehension. In addition, the person separation indexes and reliability for combined and divided instrument was found to be excellent. These result demonstrated the applicability of the WeeFIM instrument to Korean CP children with satisfactory reliability and validity.

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