Discriminative Validity of the Dutch Pediatric Evaluation of Disability Inventory

Jan W. Custers, PhD, Janjaap van der Net, PhD, Herbert Hoijtink, PhD, Jeltje E. Wassenberg-Severijnen, MA, Adri Vermeer, PhD, Paul J. Helders, PhD

ABSTRACT. Custers JW, van der Net J, Hoijtink H, Wassenberg-Severijnen JE, Vermeer A, Helders PJ. Discriminative validity of the Dutch Pediatric Evaluation of Disability Inventory. Arch Phys Med Rehabil 2002;83:1437-41.

Objective: To examine the discriminative validity of the Dutch Pediatric Evaluation of Disability Inventory (PEDI) to differentiate functional status between children with and without disabilities.

Design: Cross-sectional study.

Setting: A university children's hospital in the Netherlands.

Participants: A clinical sample comprising 197 children with disabilities (infantile encephalopathy, n=40; juvenile idiopathic arthritis, n=20; neurometabolic conditions, n=36; neuromuscular disorders, n=9; skeletal disorders, n=28; spina bifida, n=41; traumatic injury, n=23), and 62 children without disabilities.

Interventions: Not applicable.

Main Outcome Measure: Functional status was measured by using a Dutch version of the PEDI.

Results: Discriminant analysis established the sensitivity and specificity of the PEDI. Correct predictions of group membership (disabled vs nondisabled) were found in both children without disabilities (93.5% correctly predicted) and children with disabling conditions (91.6% correctly predicted).

Conclusion: The discriminative validity of the Dutch PEDI between children with and without disabilities was excellent.

Key Words: Disabled children; Rehabilitation; Reliability and validity.

THE PEDIATRIC EVALUATION of Disability Inventory (PEDI), developed by Haley et al,[1,2] is a clinical assessment of functional status in children from 6 months to 7½ years of age. It is a judgment-based structured interview for parents used by professionals in rehabilitation medicine and in health-related outcome research. The PEDI measures both capability (what the child can do) and performance (what the child actually does do) of routine daily childhood activities. It is comprised of 3 content domains—self-care, mobility, and social functioning—and results in 6 outcome scales.

A main goal of the PEDI is to detect whether a deficit or delay exists in children with respect to the functional status development and, if so, the extent and content area of the delay or deficit. The PEDI can be viewed as a discriminative outcome instrument according to the classification of Kirshner and Guyatt.[3] Feldman et al[4] examined the construct validity of the PEDI's discriminative power. They compared the outcome of the PEDI between 20 children with disabilities, that is, children with arthritic conditions and spina bifida, and a matched normative sample. The children with disabilities scored significantly lower than the children without disabilities in the self-care and mobility domains. Although the results confirmed the potentials of the PEDI to discriminate, it was based on a small sample size. Other kinds of validity studies and reliability studies have been published[1,5-8] with the original PEDI.

The applicability of the PEDI for Dutch society was examined in a preliminary study.[9] PEDI scores of Dutch children without disabilities were compared with the scores of American peers. The results showed different outcome profiles, indicating possible intercultural differences. A Dutch translation and adaptation of the PEDI[10] was subsequently conducted based on current scientific guidelines in cross-cultural research.[11-13] Four new items were added to the original PEDI, whereas some of the 197 existing items were adapted or reformulated to better fit Dutch society. Examples of these adaptations are the conversion of weights and measures into the metric system and the addition of a shower to the items concerning tub transfers. No items were eliminated from the original PEDI. The researchers of the original PEDI authorized the content of the Dutch PEDI. At the moment, the Dutch PEDI still has to be calibrated for Dutch children in the age group from 6 months to 7½ years.

In this study, we examined the discriminant validity of the Dutch PEDI to complete the adaptation process. Children with and without disabilities were included, and discriminant analysis was used to examine whether the Dutch PEDI was able to correctly identify children with functional deficits. The choice of the clinical sample was based on the assumption that a broad spectrum of functional limitations, physical and/or intellectual, was needed to capture the whole PEDI content. Therefore, we included children with central nervous system (CNS) impairments and children with musculoskeletal impairments. Regarding the first group, we included children with a known psychomotor delay, spina bifida, or infantile encephalopathy. It was assumed that functional limitations would be found in the physical as well as the cognitive domains of the PEDI in the children with CNS involvement because intellectual impairments are not uncommon in these patient groups. In addition, children with juvenile idiopathic arthritis, osteogenesis imperfecta, traumatic injury, and neuromuscular disorders represented children with musculoskeletal involvement. In these children, it was assumed that functional limitations would be found mainly in the ambulation and self-care skills. Although

From the Department of Pediatric Physical Therapy, University Medical Center/Children's Hospital Utrecht (Custers, van der Net, Helders); and the Department of Methodology and Statistics, Faculty of Social Sciences (Hoijtink) and Institute for the Study of Education and Human Development (Wassenberg-Severijnen, Vermeer), Utrecht University, Utrecht, The Netherlands.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated.

Reprint requests to J.W. Custers, PhD, Dept of Pediatric Physical Therapy, University Medical Centre/Children's Hospital, HP KB 02.056.0, PO Box 85090, 3508 AB Utrecht, The Netherlands, e-mail: *j.custers@wkz.azu.nl.*

0003-9993/02/8310-7124$35.00/0
doi:10.1053/apmr.2002.34831

Table 1: Patient Characteristics

	Age (mo)	Age (mo)	Boys	Girls	Total
NMC	35.2±17.8	10–87	22	14	36
SB	42.9±25.6	10–89	18	23	41
Skeletal	58.1±23.5	23–90	13	15	28
Encephal	64.7±17.2	23–90	28	12	40
JIA	39.0±21.5	14–88	6	14	20
Trauma	44.0±21.1	10–84	13	10	23
NMD	70.4±12.5	49–84	5	4	9
Total with disability	49.0±23.8	10–90	105	92	197
No disability	30.6±3.8	24–35	26	36	62
Total			131	128	N=259

NOTE. Values are mean ± standard deviation, range, or n.
Abbreviations: NMC, neurometabolic conditions; SB, spina bifida; Skeletal, skeletal disorders; Encephal, infantile encephalopathy; JIA, juvenile idiopathic arthritis; NMD, neuromuscular disorders.

it was not the main purpose of the study, we also looked at differences between the clinical groups.

METHODS

Participants

Between August 1999 and November 2000, 62 children without disabilities were recruited from a health care center for infants and toddlers (table 1). Parents visited this outpatient clinic for routine health assessment of their child. A clinical sample was measured between January 1999 and October 2000, comprising 197 children with different kinds of disabilities (table 1). Of them, 166 children were recruited from the University Children's Hospital and from an affiliated rehabilitation center, whereas the other 31 children were recruited from a study in children with infantile encephalopathy. All children were approached after their first visit to the outpatient's clinic within the given time frame of the study.

The clinical sample comprised 7 diagnostic groups (table 2). The children were previously diagnosed, with the exception of the children with symptoms of a neurometabolic disorder. These children, in whom there was not always a diagnosis at hand, presented different levels of psychomotor delay, sometimes associated with seizures, muscular conditions, failure to thrive, and sensory impairments. Children and parents were excluded if they were not able to actively use the Dutch language. This was determined at the introduction of the study when they were not able to iterate what they were told about the procedure.

Instrument

The child's functional capability was measured by using 3 functional skills scales of the Dutch PEDI.[1,4] These scales contain a total of 201 questions organized within 41 subscales concerning 3 domains: self-care domain, mobility domain, and social function domain (table 3). Each question is scored positive (score 1) or negative (score 0). A positive score was given when a child had mastered the particular skill. Raw scores for each subscale and per domain were summed.

The child's performance was measured by using 3 caregiver assistance scales of the Dutch PEDI.[1,4] These scales contain 20

Table 2: Clinical Samples Characteristics of Diagnosed Patients

	Subtype			
SB* (n=41)	Thoracic lesion (n=7)	Lumbar 1–3 lesion (n=8)	Lumbar 4–5 lesion (n=15)	Sacral 1–2 lesion (n=11)
Skeletal (n=28)	OI type I (n=17)	OI type III (n=5)	OI type IV (n=4)	Achondroplasia (n=2)
Encephal (n=40)	Hemiplegia (n=21)	Diplegia (n=14)	Quadriplegia (n=4)	Others (n=1)
JIA (n=20)	Monoarticular (n=2)	Oligoarticular (n=11)	Polyarticular (n=4)	Systemic (n=3)
Trauma (n=23)	Upper extremity (n=9)	Lower extremity (n=12)	Neurotrauma (CNS) (n=2)	
NMD (n=9)	Anterior horncell (n=1)	Peripheral nerve (n=3)	Muscular (n=5)	

Abbreviation: OI, osteogenesis imperfecta.
* Spina bifida with myelomeningocele (n=41) and shunted hydrocephalus (n=39).

Table 3: Item Content of the Dutch PEDI to Determine Functional Capability

Self-Care Domain*	Mobility Domain†	Social Function Domain‡
Types of food textures	Toilet transfers	Comprehension of word meanings
Use of utensils	Chair/wheelchair transfers	Comprehension of sentence complexity
Use of drinking containers	Car transfers	Functional use of communication
Tooth brushing	Bed mobility/transfers	Complexity of expressive communication
Hair brushing	Tub transfers	Problem resolution
Nose care	Indoor locomotion methods	Social interactive play
Hand washing	Distance/speed indoors	Peer interactions
Washing body and face	Pulls/carriers objects	Play with objects
Pullover/front-opening garments	Outdoor locomotion methods	Self information
Fasteners	Distance/speed outdoors	Time orientation
Pants	Outdoor surfaces	Household chores
Shoes/socks	Upstairs	Self protection
Toileting tasks	Downstairs	Community function
Management of bladder		
Management of bowel		

* Self-care domain: 74 questions in 15 subscales.
† Mobility domain: 61 questions in 13 subscales.
‡ Social function domain: 66 questions in 13 subscales.

Table 4: Item Content of the Dutch PEDI to Determine Performance

Self-Care Domain*	Mobility Domain†	Social Function Domain‡
Eating	Chair/toilet transfers	Functional comprehension
Grooming	Car transfers	Functional expression
Bathing	Bed mobility/transfers	Joint problem solving
Dressing upper body	Tub transfers	Peer play
Dressing lower body	Indoor locomotion	Safety
Toileting	Outdoor locomotion	
Bladder management	Stairs	
Bowel management		

* Self-care domain: 8 subscales.
† Mobility domain: 7 subscales.
‡ Social function domain: 5 subscales.

questions concerning the same activities of the functional skills scales (table 4). The amount of assistance is scored on a 6-point ordinal scale. Scores of 0 and 1 refer to the supportive participation of the caregiver for more than half of the activities, whereas scores of 2 to 5 refer to a progressive independence of the child. Raw scores were summed for each domain.

Procedure

Five experienced clinicians, chosen for their expertise on the relevant patient groups, interviewed the parents. The interviewers completed a training program according to the guidelines of the PEDI manual.[1] All parents (N=259) who participated in the study gave informed consent. The Dutch PEDI was administered at home or in the hospital in 105 cases; 154 interviews were administered by telephone. To improve validity, we administered the PEDI to the person who provided the most care for the child. This decision was left to the caregivers and was subsequently reported.

The parents of children with juvenile idiopathic arthritis were interviewed within a month after they visited the outpatients department for the first time. Because symptoms may vary from day to day in children with juvenile idiopathic arthritis, we standardized the interview by asking the parents to base their judgments on the past 14 days. Parents of children with a traumatic injury were interviewed within 14 days after the incident, and they were asked to base their judgments on the actual functional status. All other interviews were performed during their visit to the outpatient department or within 1 month.

Data Analysis

Based on an analysis of covariance,[14] age-corrected scale scores were computed for each of the 6 outcome scales (3 functional skills scales, 3 caregiver-assistance scales). This was necessary to correct for age differences among the 8 groups (table 1). Discriminant validity was examined by using discriminant analysis after we established the reliability and item-test correlations of each of the 6 outcome scales (which were around .94 and .78, respectively). Discriminant analysis was conducted by canonical discriminant functions[14] and was used to predict a child's group membership by using his/her 6 age-corrected scales scores. The SPSS statistical program, version 7.5,[a] was used for the analysis.

RESULTS

Table 5 presents the resulting cross-tabulation of observed and predicted group membership. The diagonal (bold) represents the amount of correctly identified children in their respective (clinical) groups based on the PEDI outcome. We found that 93.5% of the children without a disability were correctly predicted as being nondisabled, and 8.4% of the children with a disability were predicted as not having a disability, that is, 91.6% of the children with a disability were correctly predicted as being disabled.

When clustering diagnostic groups with a known CNS involvement (psychomotor delay, spina bifida, infantile encephalopathy) and diagnostic groups with a known musculoskeletal involvement (juvenile idiopathic arthritis, osteogenesis imperfecta, traumatic injury, neuromuscular disorders), discriminant analysis showed comparable high prediction rates, that is, 76.0% and 67.5%, respectively, as can be seen in table 6.

Figures 1 and 2 show standardized means of the 6 subscales used to examine the relative differences in functional status among the respective groups. The standardized means from the children without a disability were higher for all 6 subscales of the PEDI.

DISCUSSION

The aim of discriminative measures is to distinguish between individuals or groups on underlying dimensions.[3] Discriminative measures in rehabilitation medicine are useful to determine the impact of a disorder with respect to functional status at a single point of time. The purpose of this study was to examine

Table 5: Classification Results

	Predicted Group Membership								
Observed	No Disability	NMC	SB	Skeletal	Encephalopathy	JIA	Trauma	NMD	Total
No disability	**93.5**	1.6	0.0	1.6	.0	3.2	0.0	0.0	100.0
NMC	5.6	**75.0**	0.0	0.0	8.3	8.3	0.0	2.8	100.0
SB	4.9	24.4	**39.0**	7.3	7.3	2.4	7.3	7.3	100.0
Skeletal	10.7	3.6	7.1	**21.4**	17.9	21.4	14.3	3.6	100.0
Encephal	10.0	22.5	10.0	5.0	**42.5**	2.5	5.0	2.5	100.0
JIA	10.0	5.0	10.0	.0	.0	**50.0**	5.0	20.0	100.0
Trauma	17.4	8.7	4.3	4.3	8.7	4.3	**43.5**	8.7	100.0
NMD	0.0	0.0	0.0	0.0	11.1	22.2	22.2	**44.4**	100.0
All disability	**8.4**								

NOTE. Predicted group membership in percentiles.

Table 6: Classification Results

Observed	Predicted Group Membership			
	No Disability	CNS	MSI	Total
No disability	**93.5**	1.6	4.9	100.0
CNS	6.8	**76.0**	17.2	100.0
MSI	11.3	21.2	**67.5**	100.0

NOTE. Predicted group membership in percentiles. CNS includes psychomotor delay, spina bifida and infantile encephalopathy. Musculoskeletal involvement (MSI) includes skeletal disorders, juvenile idiopathic arthritis, traumatic injury, and neuromuscular disorder.

the discriminative validity of the Dutch-adapted PEDI, that is, the ability of the Dutch PEDI to discriminate between children with and without disabilities with respect to functional status. This question was solved by using discriminant analysis. However, we first performed an analysis of covariance and computed age-corrected scale scores, because discriminant analysis could not be conducted in this study with children of the same age because the sample sizes were too small.

Because 93.5% of the children without disabilities were correctly predicted as being nondisabled (based on the PEDI outcome) and 91.6% of the children with disabilities were correctly predicted as being disabled, we concluded that the Dutch PEDI's discriminative validity is excellent between children with and without disabilities. Our findings confirm a high degree of sensitivity (correct identification of children with disabilities within this population) and specificity (false prediction of children without disabilities who were identified as disabled).

In our study, we were unable to compare the differences between patient groups, mostly because of the lack of homogeniety in the sample base, varying degrees of disease severity within a group, and a lack of data on the intellectual skills of the children. However, 2 major groups were distinguished, and thereby a high percentage of the children with CNS and musculoskeletal involvement could be correctly predicted (table 6). This is also shown in figure 2, which presents similar *z*-score profiles of patient groups with a musculoskeletal involvement, in contrast to the patient groups with a CNS involvement (fig 1). This is at least suggestive for further support of a good discriminant validity of the Dutch PEDI. Future studies are needed to establish the discriminative validity of the PEDI between homogeneous but different diagnostic groups.

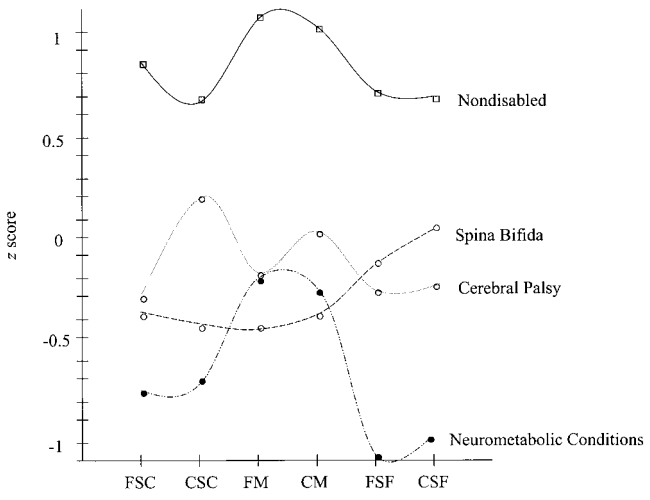

Fig 1. Standardized scores for age-corrected scales for patients with CNS involvement. Abbreviations: FSC, functional skills scale: self-care domain; CSC, caregiver assistance scale: self-care domain; FM, functional skills scale: mobility domain; CM, caregiver assistance scale: mobility domain; FSF, functional skills scale: social function domain; CSF, caregiver assistance scale: social function domain.

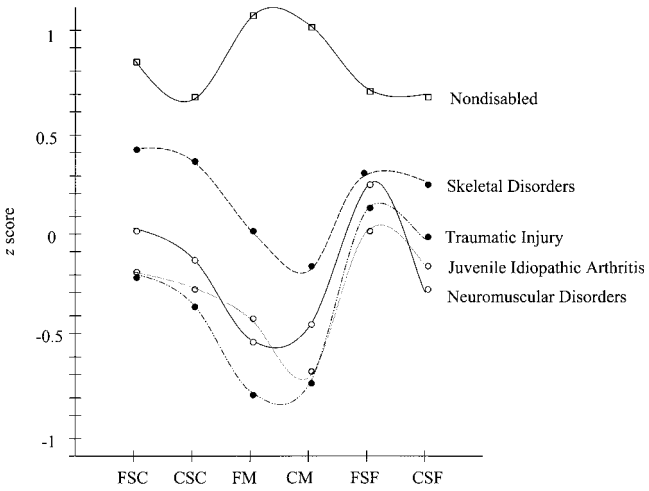

Fig 2. Standardized scores for age-corrected scales for patients with musculoskeletal involvement.

CONCLUSION

This study confirmed that the Dutch PEDI has excellent discriminative validity with respect to functional status of daily activities of children with and without disabilities. The results establish the applicability of the PEDI for discriminative purposes in the patient groups used in this study. Therefore, the PEDI can serve as a diagnostic tool for professionals in pediatric rehabilitation medicine.

References

1. Haley SM, Coster WJ, Ludlow LH, Haltiwanger JT, Andrellos PJ. Pediatric Evaluation of Disability Inventory: development, standardization, and administration manual. Boston: New England Medical Center, PEDI Research Group; 1992.
2. Coster WJ, Haley SM. Conceptualization and measurement of disablement in infants and young children. Infants Young Child 1992;4:11-22.
3. Kirshner B, Guyatt GH. A methodological framework for assessing health indices. J Chronic Dis 1985;38:27-36.
4. Feldman AB, Haley SM, Coryell J. Concurrent and construct validity of the Pediatric Evaluation of Disability Inventory. Phys Ther 1990;70:602-10.
5. Haley SM, Coster WJ, Faas RM. A content validity study of the Pediatric Evaluation of Disability Inventory. Pediatr Phys Ther 1991;3:177-84.
6. Nichols DS, Case-Smith J. Reliability and validity of the Pediatric Evaluation of Disability Inventory. Pediatr Phys Ther 1996;8:15-24.
7. Wright FV, Boschen KA. The Pediatric Evaluation of Disability Inventory (PEDI): validation of a new functional assessment outcome instrument. Can J Rehabil 1993;7:41-2.
8. Ketelaar M. Children with cerebral palsy: a functional approach to physical therapy [dissertation]. Utrecht (Netherlands): Faculty of Social Sciences, Utrecht Univ; 1999.
9. Custers JW, Hoijtink H, van der Net J, Helders PJ. Cultural differences in functional status measurement: analyses of person fit according to the Rasch model. Qual Life Res 2000;9:571-8.

10. Custers JW, Wassenberg-Severijnen JE, van der Net J, Vermeer A, Hart H, Helders PJ. Dutch adaptation and content validity of the 'Pediatric Evaluation of Disability Inventory' (PEDI). Disabil Rehabil 2002;24:250-8.
11. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol 1993;46:1417-32.
12. Touw-Otten F, Meadows K. Cross-cultural issues in outcome measurement. In: Hutchinson A, McColl E, Christie M, Riccalton C, editors. Health outcome measures in primary and outpatient care. Amsterdam: Harwood Academic Publishers; 1996. p 99-208.
13. Herdman M, Fox Rushby J, Badia X. 'Equivalence' and the translation and adaptation of health-related quality of life questionnaires. Qual Life Res 1997;6:237-47.
14. Stevens J. Applied multivariate statistics for the social sciences. 3rd ed. Mahwah (NJ): Lawrence Erlbaum Associates; 1996.

Supplier

a. SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.