

Reliability of the Family Impact of Assistive Technology Scale for Families of Young Children With Cerebral Palsy

Stephen E. Ryan, BESC, PEng, Kent A. Campbell, PhD, Patricia J. Rigby, MHSc, OTReg (Ont)

ABSTRACT. Ryan SE, Campbell KA, Rigby PJ. Reliability of the Family Impact of Assistive Technology Scale for families of young children with cerebral palsy. *Arch Phys Med Rehabil* 2007;88:1436-40.

Objective: To examine the internal consistency and test-retest reliability of the Family Impact of Assistive Technology Scale (FIATS) when used to measure the perceptions of parents about important aspects of family life that may be influenced by their children's use of assistive devices.

Design: Repeated measure.

Setting: Homes of 50 participating families.

Participants: Parents of young children with cerebral palsy.

Interventions: Not applicable.

Main Outcome Measure: The FIATS.

Results: Through an a priori item-reduction process, we reduced the length of the FIATS from 89 to 64 items. We retained 8 of the 9 original subscales. The 8 subscales included the following: autonomy, caregiver relief, contentment, doing activities, effort, family and social interaction, caregiver supervision, and safety. Remaining items of the removed subscale (technology acceptance) correlated well with the subscale total, but did not relate well to the FIATS total score. This construct was retained as a separate but noncontributing scale within the FIATS. The overall FIATS and its 8 contributing subscales had acceptable internal consistencies and test-retest reliabilities.

Conclusions: The FIATS shows promise as a homogeneous and reproducible multidimensional measure of dimensions of child and family life. We plan further testing to examine the sensitivity and clinical meaningfulness of change scores on the FIATS.

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

© 2007 by the American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation

From Bloorview Research Institute, Bloorview Kids Rehab, Toronto, ON, Canada (Ryan, Campbell, Rigby); and Department of Occupational Science and Occupational Therapy (Ryan, Campbell, Rigby), Department of Public Health Sciences, and Graduate Department of Rehabilitation Sciences (Campbell), University of Toronto, Toronto, ON, Canada.

Presented to the 22nd International Seating Symposium, March 2, 2006, Vancouver, BC, Canada, and the 23rd International Seating Symposium, March 9, 2007, Orlando, FL.

Supported by the SickKids Foundation/Institute for Human Development, Child and Youth Health-Canadian Institutes of Health Research (grant no. XG 04-088) and Bloorview Childrens Hospital Foundation (grant no. F04-11).

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.

Correspondence to Stephen E. Ryan, BESC, PEng, Bloorview Research Institute, Bloorview Kids Rehab, 150 Kilgour Rd, Toronto, ON M4G 1R8, Canada, e-mail: sryan@bloorview.ca. Reprints not available from the author.

0003-9993/07/8811-00232\$32.00/0

doi:10.1016/j.apmr.2007.06.777

PARENTS WHO HAVE young children with complex physical disabilities face challenges that are both physically and emotionally demanding. Parents of children with disabilities spend more time providing child assistance and supervision than other parents because their children are unable to do many everyday activities on their own.^{1,2} These added responsibilities, for mothers in particular, translate into less time attending to their own needs, the needs of their other children, and household chores. Most mothers do not have time to work outside the home.²⁻⁴

Investigators have reported significantly higher stress levels in parents of children with developmental disabilities,⁵ autism and pervasive developmental disorders,⁶ Down syndrome,⁷ and cerebral palsy (CP)⁸ when compared with the stress levels experienced by parents of the same-aged children without disabilities. Other researchers suggest that parents of children with disabilities have a higher risk of child maltreatment,⁵ dysfunctional relationships,⁹ and unemployment¹⁰ than parents of children without disabilities.

We hypothesized that assistive devices used by young children with complex positioning problems at home would enhance functional outcomes for children and provide a measurable form of relief for families by reducing caregiver burden. By using outcome measures with high levels of reliability and validity to study the role that these technologies play in the lives of families, we may better understand their facilitating effects. However, measures with good psychometric properties are either unavailable or not sensitive enough to measure the effect that enabling technologies have on family life.

We developed the Family Impact of Assistive Technology Scale (FIATS), a measure designed to detect the multidimensional effect of assistive device use on families who have young children with disabilities, to fill this measurement need. We initiated the development of the FIATS by reviewing the literature and identifying domains that assistive devices could influence. We conceptualized the impact of the use of assistive devices on family life as a latent variable defined by the measurement of items that related to each of these domains.

We consulted with clinical experts and parents to assess the relevance of the proposed domains, estimate its content validity, and identify new content areas. This process yielded 9 dimensions of child and family life that assistive devices could affect. The dimensions included the following: autonomy, caregiver relief, contentment, doing activities, effort, family and social interaction, caregiver supervision, safety, and technology acceptance.

We generated a pool of items that addressed these content areas. Parents of children with CP evaluated the clarity of these items and examined the face validity of the FIATS by using a consensus-building approach that we developed. We showed that the FIATS has very good face validity and content validity. Details of this earlier exploration are reported elsewhere.¹¹

The preliminary version of the FIATS developed from this earlier study had 89 statements that tapped into 1 of the

	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree	Subscale
I have little time to get chores done around the house.*	7	6	5	4	3	2	1	Supervision
I'd like my child to be as independent as possible.	7	6	5	4	3	2	1	Supervision
It is easier to play with my child when someone is holding him/her.*	7	6	5	4	3	2	1	Family/social interaction
My child socializes with others at mealtimes.	7	6	5	4	3	2	1	Family/social interaction

Fig 1. Sample items from the preliminary version of the FIATS. *Reverse scored.

9 subscales identified by content experts as being relevant to the scale's intended purpose (appendix 1). This version of the FIATS was used in the present study.

The FIATS included a 7-point Likert scale to record the degree to which parents agreed or disagreed with each statement as shown in figure 1. To reduce the likelihood of rater bias, subscale items were randomly assigned throughout the FIATS, and 48% of the statements were reverse scored.

The preliminary version of the FIATS showed very good content and face validity. The objective of the present research study was to (1) improve the homogeneity of the FIATS by adopting an a priori item reduction method, (2) estimate the internal consistency of the revised FIATS and its subscales, and (3) estimate the test-retest reliability of the FIATS.

METHODS

We received ethics clearance for the study from the Research Ethics Board at Bloorview Kids Rehab, a fully affiliated teaching hospital of University of Toronto located in Toronto, ON, Canada.

Participants

We invited parents and their young children who were clients of 1 of 3 regional children's rehabilitation centers in southeastern Ontario, Canada, to join this study. These centers included our children's center (Bloorview), Erinoak, and Grandview Children's Centre. Eligible parents cared for children who (1) had a primary diagnosis of CP with a functional status defined by Gross Motor Function Classification System¹² level III or IV, (2) were between 2 years 6 months and 7 years 6 months, and (3) lived in a geographical area served by 1 of the 3 participating rehabilitation facilities. After a review of electronic medical records for children with this level of disability, we identified 347 children who met the initial inclusion criteria.

We sent a letter to these families to introduce the study. We telephoned parents of children who were Bloorview clients 1 to 2 weeks later by using a uniform randomization approach to provide each family with an equal chance of being invited to participate. We used a different recruitment procedure for the other 2 participating centers to protect the privacy of the children and their families. Our collaborators from the other 2 centers mailed letters to families to invite them to contact our study coordinator if they were interested in being involved.

We developed and used a screening questionnaire to identify parents who (1) were primary caregivers, defined as providing not less than 10 hours of direct supervision per day, and (2) did not use specialized postural control devices to support their children at home for floor sitting, chair sitting, and toileting activities. We included children who

did not use specific postural control devices at home because we invited their parents to participate in a follow-up intervention study to examine the effect of these devices on family life by using the FIATS. The outcomes of this intervention study are not considered here.

We explained the project protocol and expectations of participants during the telephone call. We mailed an information letter to caregivers who were interested and met our screening criteria. Each participant provided signed consent. Recruitment continued until 50 families were enrolled in the study.

Of the 258 families we contacted, 162 families did not satisfy the screening requirements, 24 families declined because of scheduling conflicts, 16 families met the screening criteria but later declined after receiving more information about the project by mail, 6 children were deemed clinically ineligible by the research occupational therapist during the first home visit, and 50 families agreed to participate. We recruited 45 families from Bloorview Kids Rehab and the remaining 5 families from the other 2 children's centers to reach our target sample of 50 families.

Protocol

One of 2 research occupational therapists conducted interviews in the homes of families. At the first home appointment, the therapist used a questionnaire that we developed to interview a parent to gather basic demographic information including the number of family members, the school schedule of the child, and the number of hours the parent worked out of the home. For this reliability study, we asked parents to complete the FIATS twice, once at the first home visit and again 2 to 3 weeks later during the second visit. Although we administered other questionnaires during the home visits, these were not included in the reliability analyses so are not discussed further.

Statistical Analysis

We adopted an a priori item reduction strategy based on the recommendations of health measurement scale authorities.¹³ Our general plan was to identify and eliminate those items that did not correlate well with the overall FIATS scale or the subscale to which they were assigned. Specifically, we compiled data from the first administration of the FIATS and eliminated items in the following order:

1. Items with more than 80% of respondents selecting the same rating for a particular item were discarded
2. Items that had low corrected item-total FIATS scale correlations, defined as the Pearson $|r|$ less than 0.2, were eliminated
3. Items with low corrected item-total subscale correlations ($|r| < 0.2$) were correlated with other subscales. If the item-other subscale correlation was equal to or greater than 0.2, the item was reassigned to another

Table 1: Selected Descriptive Statistics for Scales, α Coefficients, and Test-Retest Reliability ICCs of the Revised Version of the FIATS, Its 8 Subscales, and the Technology Acceptance Subscale

Subscale	No. of Items	Mean \pm SD	Cronbach α	ICC	95% CI for ICC
Autonomy	5	4.12 \pm 1.19	.73	.84	.73-.91
Caregiver relief	9	3.57 \pm 1.26	.89	.89	.80-.94
Contentment	9	4.13 \pm 0.93	.72	.87	.77-.93
Doing activities	5	5.11 \pm 1.04	.68	.89	.80-.94
Effort	8	2.95 \pm 1.26	.81	.83	.70-.90
Family/social interaction	4	5.45 \pm 0.77	.64	.77	.59-.87
Safety	8	3.25 \pm 0.89	.70	.87	.77-.93
Supervision	7	3.67 \pm 1.15	.73	.92	.87-.96
Total sum of means for revised FIATS	55	32.25 \pm 6.63	.94	.92	.86-.95
Technology acceptance	9	6.46 \pm 0.57	.92	.81	.66-.89

Abbreviations: CI, confidence interval; SD, standard deviation.

subscale if it related conceptually to the other subscale construct. Otherwise, the item was eliminated.

- Item-total other subscale correlations were calculated for the remaining items to confirm that they were assigned to the correct subscales. The item was reassigned if it had a higher item-subscale total correlation with the other subscale and was related conceptually to the other subscale.
- Other nonhomogeneous items were identified and eliminated by repeating the correlational analysis by using the reduced scale and repeating steps 2 to 4.

For steps 3 and 4, we and a project research therapist collectively reviewed each item with a higher item-total other subscale correlation than the correlation with its own scale. Items were reassigned to the new subscale only if all researchers agreed that the item was related conceptually to the other subscale construct. Otherwise, the item remained assigned to its original scale.

To evaluate the internal consistency of the revised FIATS, we calculated the Cronbach α for the total scale and subscales by using data from the first administration of the FIATS. We estimated test-retest reliability by using intraclass correlation coefficients (ICCs) and data from the 2 administrations of the FIATS. Measurement authorities suggest homogeneous scales should have α between 0.7 and 0.9, and test-retest reliability ICCs should be in the range of .65 and 0.9 for research purposes.^{13,14}

RESULTS

Demographics

Forty-eight mothers and 2 fathers of children who met the inclusion criteria participated in the study. Eighty-six percent of the parents had at least 2 children. Forty-three parents had children with CP who attended either elementary or nursery school during the week either full-time or part-time, and the remaining 7 parents had children with CP who were too young to attend school.

At the time of study enrollment, most children had some form of assistive technology that they used in the home. The most common assistive device was a wheelchair or stroller with specialized seating. When not in the wheelchair, parents reported their children had to be positioned by an assortment of pillows, family members, or using modified juvenile equipment such as a high chair or car seat. Home-made devices such as modified potty seats and corner seats were less common but were used occasionally to provide alternate positioning for children.

Item Reduction

We used the a priori strategy described previously to identify items that did not correlate well with the overall FIATS scale and its own subscale. Two statements received the same rating 80% of the time or more, 27 items had low item-total FIATS correlations (ie, $|r| < 0.2$) and 7 items had low item-subscale total correlations. All items on the technology acceptance subscale had low correlations with the total FIATS. However, only 1 of the 10 items on this subscale had a low item-total correlation with its own subscale.

Eight statements on specific scales had item-total scores above the lower correlation threshold (ie, $|r| < 0.2$) but had higher correlations with other subscales. On our review of the relevance of these 8 items to the other subscales, we concurred that all items should remain assigned to their original subscales.

Initially, 36 items were eliminated from the FIATS. On recalculating the item-total scale and subscale correlations for the reduced version of FIATS, 2 more items were eliminated because of an absolute item-total correlation of less than 0.2, thereby leaving a total of 55 contributing items on the FIATS.

Reliability of the FIATS

A summary of the descriptive and reliability statistics for the item-reduced version of FIATS, its 8 contributing subscales, and the technology assistance subscale is provided in table 1. Seven subscales had Cronbach alphas that were within the range of 0.7 to 0.9. The 2 remaining subscales had alphas above 0.6. For the total, the FIATS scale α exceeded 0.9.

The point estimate of the test-retest reliability for the overall FIATS scale was .92, as measured by the ICC. The ICC point estimates for test-retest reliability for all subscales were between .77 and .92. The 95% confidence intervals (CIs) for all subscale ICCs extended from .59 to .96.

DISCUSSION

Following our a priori strategy to reduce the items, we eliminated 40% of the items from the FIATS. Although all 9 items on the technology acceptance subscale had item-total FIATS scale correlations below the r equals 0.2 threshold, its internal consistency was high ($\alpha = .92$) and the test-retest reliability was good (ICC = .81; 95% CI, .66-.89). This suggests that the items on the subscale do not contribute to the overall FIATS score but do tap into another construct that appears to be stable over time. Consequently,

we retained the technology acceptance subscale as a separate measure within the FIATS, but its ratings did not contribute to the overall scoring for the FIATS.

The FIATS had a high internal consistency as measured by its coefficient, which exceeded 0.9. This suggests that there may have been some redundancy within the scale caused by a few items measuring the same attributes.¹³ Six contributing subscales on the FIATS showed acceptable internal consistency. The items on these scales related well to the subscale total and the overall FIATS total score. Only the family/social interaction and doing activities subscales had α below the preferred range of 0.7 to 0.9, suggesting possible inconsistency across items that comprised these scales.

Of interest are the very good test-retest reliabilities of the FIATS and its subscales. All scales have estimates of reliability that are within the preferred limits for measures of group performance.¹³ Only 1 subscale (ie, family/social interaction) had a lower 95% CI that was below an acceptable test-retest ICC of .65.

The parents who participated in this study were similar in that they had young children with CP who we would expect to benefit from the use of assistive technology for positioning, mobility, and activities of daily living. Many children had assistive devices for mobility, whereas very few had other commercial devices for postural control.

We calculated the revised FIATS score by determining the sum of the mean subscale scores. Hence, overall FIATS scores could range from 8 to 56. In this study, the mean FIATS score \pm standard deviation was 32.3 ± 6.6 or about 67% of the total possible score. This suggests that for this sample of parents of children with disabilities, there is room on the FIATS to measure an effect on family life caused by the introduction and use of postural control devices by children.

Study Limitations

Our study involved a sample of primary caregivers of children with CP who were clients of 3 children's rehabilitation centers in the greater Toronto area. Because our reliability estimates for the FIATS and its subscales apply to this study population, our findings may not extend to parents who live in other community settings, have different levels of caregiving responsibilities, or have children with other physical disabilities.

CONCLUSIONS

It is important for rehabilitation clinicians to adopt and use measures that are sensitive to understand the impact that enabling interventions like assistive devices have on family life. Although it is important to know the extent to which the measured differences are also meaningful to children and their families, we must first show that the measures are internally reliable and stable over time.

The FIATS shows promise as a stable measure of the perceived impact of postural control devices used by young children with CP in their home environments. Our study suggests that in its revised form overall the FIATS has acceptable internal consistency and test-retest reliability. This is the first study that explored the homogeneity and reproducibility of the FIATS and its subscales. With additional estimates of the test-retest reliability in other well-designed studies, the psychometric rigor of this new measure will be strengthened.

We plan to evaluate the sensitivity and responsiveness of the FIATS to measure change in child and family life caused

by the introduction and use of postural control devices. We also intend to explore the relationship of the FIATS with other standardized outcome measures and other populations of children who need assistive devices. With this additional evidence of validity, we expect that the FIATS will provide clinicians and researchers with a new measurement scale to study the role that assistive devices play in the lives of families of children with CP and other complex needs.

Acknowledgments: We appreciate the support provided by our research colleagues Barbara Fishbein-Germon, MSW, RSW, Betty Chan, MSc, OTReg(Ont), Darlene Hubley, BSc, OTReg(Ont), and Joan Walker. We also appreciate the assistance provided by our clinical colleagues at Erinoak and Grandview Children's Centre. We appreciate the helpful comments provided by Peter Rosenbaum, MD, FRCP, on an earlier version of this article.

APPENDIX 1: SUBSCALES OF THE PRELIMINARY VERSION OF THE FIATS

Subscale	Definition	Number of Items
Autonomy	Degree to which the child can perform activities independently.	7
Caregiver relief	Degree to which parent needs relief from caregiving.	11
Contentment	Degree to which the child is content during the day.	12
Doing activities	Degree to which the child has control over his/her own actions.	13
Effort	Degree of energy needed to assist the child.	9
Family/social interaction	Degree to which the child interacts with others.	9
Safety	Degree to which parent is worried about the child's safety.	10
Supervision	Degree to which the child requires attention from family members.	8
Technology acceptance	Degree to which the parent accepts assistive devices for the child.	10
Total number of items		89

References

- Curran AL, Sharples PM, White C, Knapp M. Time costs of caring for children with severe disabilities compared with caring for children without disabilities. *Dev Med Child Neurol* 2001;43:529-33.
- Roberts K, Lawton D. Acknowledging the extra care parents give their disabled children. *Child Care Health Dev* 2001;27:307-19.
- Crowe TK. Time use of mothers with young children: the impact of a child's disability. *Dev Med Child Neurol* 1993;35:621-30.
- Tetreault S, Beaulieu J, Martin G, Bedard J, Laurion S. [Time management: realities for parents living with children with motor deficiencies] [French]. *Can J Occup Ther* 2000;67:260-70.
- Cowen PS, Reed DA. Effects of respite care for children with developmental disabilities: evaluation of an intervention for at risk families. *Public Health Nurs* 2002;19:272-83.
- Tobing LE, Glenwick DS. Relation of the Childhood Autism Rating Scale-Parent version to diagnosis, stress, and age. *Res Dev Disabil* 2002;23:211-23.

7. Byrne EA, Cunningham CC. Lifestyle and satisfaction in families of children with Down's syndrome. In: Brown RI, editor. *Quality of life for handicapped people*. New York: Croom Helm; 1988. p 83-110.
8. Button S, Pianta RC, Marvin RS. Partner support and maternal stress in families raising young children with cerebral palsy. *J Dev Phys Dis* 2001;13:61-81.
9. Patterson J, Barlow J, Mockford C, Klimes I, Pyper C, Stewart-Brown S. Improving mental health through parenting programmes: block randomised control trials. *Arch Dis Child* 2002;87:472-7.
10. Thyen U, Kuhlthau K, Perrin JM. Employment, child care, and mental health of mothers caring for children assisted by technology. *Pediatrics* 1999;103(6 Pt 1):1235-42.
11. Ryan S, Campbell KA, Rigby P, Germon B, Chan B, Hubley D. Development of the new Family Impact of Assistive Technology Scale. *Int J Rehabil Res* 2006;29:195-200.
12. Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and validation of a gross motor function classification system for children with cerebral palsy. *Dev Med Child Neurol* 1997;39:214-23.
13. Streiner D, Norman G. *Health measurement scales: a practical guide to their development and use*. 3rd ed. Oxford: Oxford Univ Pr; 2003.
14. Law M. Measurement in occupational therapy: scientific criteria for evaluation. *Can J Occup Ther* 1987;54:133-8.