ORIGINAL ARTICLE

Linking the Activity Measure for Post Acute Care and the Quality of Life Outcomes in Neurological Disorders

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ABSTRACT. Haley SM, Ni P, Lai J-S, Tian F, Coster WJ, Jette AM, Straub D, Cella D. Linking the Activity Measure for Post Acute Care and the Quality of Life Outcomes in Neurological Disorders. Arch Phys Med Rehabil 2011;92 (10 Suppl 1):S37-43.

Objective: To use item response theory (IRT) methods to link physical functioning items in the Activity Measure for Post Acute Care (AM-PAC) and the Quality of Life Outcomes in Neurological Disorders (Neuro-QOL).

Design: Secondary data analysis of the physical functioning items of AM-PAC and Neuro-QOL. We used a nonequivalent group design with 36 core items common to both instruments and a test characteristic curve transformation method for linking AM-PAC and Neuro-QOL scores. Linking was conducted so that both raw and scaled AM-PAC and Neuro-QOL scores (mean ± SD converted-logit scores, 50±10) could be compared.

Setting: AM-PAC items were administered to rehabilitation patients in post–acute care (PAC) settings. Neuro-QOL items were administered to a community sample of adults through the Internet.

Participants: PAC patients (N=1041) for the AM-PAC sample and community-dwelling adults (N=549) for the Neuro-QOL sample.

Interventions: Not applicable.

Main Outcome Measures: Mobility (N=25) and activity of daily living (ADL) items (N=11) common to both instruments were included in analysis.

Results: Neuro-QOL items were linked to the AM-PAC scale by using the generalized partial credit model. Mobility and ADL subscale scores from the 2 instruments were calibrated to the AM-PAC metric.

Conclusions: An IRT-based linking method placed AM-PAC and Neuro-QOL mobility and ADL scores on a common metric. This linking allowed estimation of AM-PAC mobility and ADL subscale scores based on Neuro-QOL mobility and ADL subscale scores and vice versa. The accuracy of these results should be validated in a future sample in which participants respond to both instruments.

Key Words: Linking; Neurologic diseases; Outcome assessment (health care); Rehabilitation.

AN ANTICIPATED FEATURE of contemporary patient-reported outcome (PRO) instruments for clinical populations has been the ability to link items of old and new instruments by calibrating scores to a common metric.[1,2] Placing items from different PRO instruments on a common metric and developing a linkage between their scores allows us to identify scores on different measures that have comparable meaning. These procedures are fundamental to creating a "network" of assessments that can be compared with one another in future clinical research.[3]

Traditional raw-score or classical test theory (CTT) approaches have been used to develop cross-walk tables for instruments used in rehabilitation medicine, including comparing the FIM and Minimal Data Set (MDS) items and scores[4] and the FIM and MDS-Post Acute Care (PAC) scores.[5,6] Both studies yielded only marginal results, with important discrepancies found in certain item-to-item matches. Objections to using a CTT approach include potential error from developing item-to-item matches based on expert panels and test dependency with the individual samples selected for the linking study.[7]

More recently, linking of instruments in rehabilitation medicine has been accomplished by using item response theory (IRT) models. Assuming that the PRO constructs of different instruments are measuring the same dimension, IRT methods develop

List of Abbreviations

ADL	activity of daily living
AM-PAC	Activity Measure for Post Acute Care
CAT	computer adaptive test
CFA	confirmatory factor analysis
CFI	comparative fit index
CTT	classical test theory
DIF	differential item function
EFA	exploratory factor analysis
GPCM	generalized partial credit model
IRT	item response theory
MDS	Minimal Data Set
Neuro-QOL	Quality of Life Outcomes in Neurological Disorders
PAC	post–acute care
PRO	patient-reported outcome
RMSEA	root mean square error approximation
SCI	spinal cord injury
TLI	Tucker-Lewis Index

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correspondence tables and figures to describe the association of equivalent scores for different instruments. To overcome test dependency, both instruments are placed onto a common metric. Under IRT, linking can be accomplished by transforming item parameter estimates from 1 test to the metric of a second test. For example, McHorney[8] successfully used an IRT approach to link 3 physical functioning items on a common continuum and Velozo et al[7] linked the FIM and MDS by using Rasch methods and conducted a validation study.[9]

A number of current projects are attempting to build scoring links by selecting common items that will be administered in both instruments. For example, a number of core items have been developed and are being tested in 2 separate item bank development projects, 1 for children[10] with spinal cord injury (SCI) and 1 for adults with SCI.[11] The goal is to link the 2 instruments so that scores from the pediatric SCI instrument can be related to scores in the adult SCI instrument for comparability in long-term follow-up. Other projects that will provide score linking opportunities include work by Tulsky and colleagues, who are co-calibrating Quality of Life Outcomes in Neurological Disorders (Neuro-QOL) items[12] with items specifically developed for persons with SCI. In this study, we chose to link 2 instruments because of their common content domains and items.

IRT linking studies include both a sampling and a linking strategy.[13] Sampling procedures consist of common subjects, common items, or some combination of common items and subjects. Linking procedures include either putting all items on a single scale (common calibration) or using calibrations from common items to create a link between the 2 instruments.[2] In the present project, we had available data from 2 instruments with common items but different samples, yielding a nonequivalent group sampling design. The use of common items for subsequent linking was part of the initial design and development of Neuro-QOL. Neuro-QOL incorporated a number of items from the Activity Measure for Post Acute Care (AM-PAC) within its lower-extremity function (mobility) and upper-extremity function (fine motor, activity of daily living [ADL]) item pools. Although the initial calibration work with Neuro-QOL used a community-dwelling adult database and AM-PAC used a sample of PAC patients, having a set of core items administered in both samples allowed for linking the instruments. Our linking design used linking coefficients from common items to create corresponding scoring tables. This linking design was chosen because of adequate sample size availability[14] and the desire to maintain the original calibrations of the AM-PAC, which had been calibrated previously. The purposes of this article are to demonstrate the use of a nonequivalent sampling design using linking coefficients from common items to develop score conversions for the physical functioning domains of the AM-PAC and Neuro-QOL.

METHODS

Sample and Procedures

Our methods included a nonequivalent group design with common items administered to both community-dwelling and clinical samples. In the development of scoring links, we defined common items and used a test characteristic curve transformation method to develop linking coefficients for the conversion of scores to the same scale. Test characteristic curves are mathematical equations that estimate total score on the same measure, conditional on participants' levels of the trait being measured. Pairs of scores from 2 different instruments are equivalent if they correspond to the same level of the trait being measured.

Using a nonequivalent sampling approach, we drew upon data from 2 samples. For the AM-PAC, data were collected from 1041 participants aged 18 years and older from 6 regional rehabilitation networks. Exclusion criteria included (1) non–English-speaking patients and (2) patients who were in a coma, debilitated, or agitated to a degree that precluded participation in active rehabilitation. AM-PAC data were collected by means of semistructured interviews by either the participant's clinician or a trained data collector. Each interview (~45–60min) was fully scripted with standard instructions, practice questions, and an answer card to help subjects communicate response choices. A subject's ability to respond to self-report questions was assessed by the treating clinician or assigned data collector, who determined whether the participant could (1) understand the interview questions, (2) sustain attention for an hour, and (3) reliably respond to questions. Full details of the data collection procedures have been reported previously.[15]

The Neuro-QOL sample (N=549) consisted of adults without neurologic conditions who were part of an Internet-based opt-in panel, YouGovPolimetrix (www.polimetrix.com; also see www.pollingpoint.com), a polling firm based in Palo Alto, CA. YouGovPolimetrix operates PollingPoint.com, a centralized portal that allows interested individuals to provide their views about public policy and other current issues. Respondents for a typical YouGovPolimetrix Internet survey are selected from the PollingPoint panel, a panel of more than 1 million respondents who have provided YouGovPolimetrix with their names, street addresses, e-mail addresses, and other information and who regularly participate in online surveys. Panelists were recruited by a variety of methods, including e-random digit dialing, invitations through web newsletters, and Internet poll-based recruitment, in which panelists have opted to participate in a survey advertised on the World Wide Web. Panel members receive modest compensation (<$10 value) when they participate.

Physical Functioning Measures

Activity Measure for Post Acute Care. The AM-PAC measures functional activity in adults across all PAC settings. Early content and analytic work with the AM-PAC established 3 major activity content domains upon which AM-PAC dimensions are based: (1) basic mobility, (2) daily activities, and (3) life skills.[16] Only analyses of the basic mobility and daily activity items are reported in this article. A number of versions of the AM-PAC instrument have been developed, with the current version based on a sample of 1041 PAC patients. AM-PAC uses a 4-point difficulty rating scale (no difficulty, a little difficulty, a lot of difficulty, cannot/unable to do). Both AM-PAC short forms and computer adapted test (CAT) formats have been developed. We conducted a series of simulated validation tests of the AM-PAC CAT software on numerous PAC samples, including patients with stroke[17] and complex medical conditions[18] and prospective work on patients with orthopedic conditions.[19,20] We found AM-PAC to be responsive to short- (3mo)[21] and long-term (12mo) changes in PAC patients.[22] A staging system to help characterize the meaning of scores also has been developed.[23] We used the original set of community-dwelling calibrations for the AM-PAC and removed only walking aid device items (rare in the Neuro-QOL normative sample) from analysis. To develop consistency with parallel Neuro-QOL domains, we refer to the AM-PAC basic mobility scale as mobility and the AM-PAC daily activity scale as ADL.

Quality of Life Outcomes in Neurological Disorders. Neuro-QOL is a 5-year multisite National Institute of Neurological Disorders and Stroke–funded project that aims to develop a clinically relevant and psychometrically robust health-related quality-of-life assessment tool that will be responsive to the needs of researchers who work with adults and children with a variety of neurologic disorders. Physical function item banks were among those developed under Neuro-QOL.