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# Measuring disability in chronic pain: Factor structure and revision of the Sickness Impact Profile

Mindy McEntee

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**MEASURING DISABILITY IN CHRONIC PAIN:  
FACTOR STRUCTURE AND REVISION OF THE  
SICKNESS IMPACT PROFILE**

**by**

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**ABSTRACT**

Chronic pain is a complex condition that can adversely impact all areas of one's life. Despite a wealth of treatment options, complete pain relief is rare. Consequently, treatment goals often aim to improve functioning in physical, psychological, and social domains. Assessments play an important role in planning treatment and monitoring changes in functioning, but must balance comprehensiveness with patient burden. The Sickness Impact Profile (SIP; Bergner, Bobbitt, Carter, & Gilson, 1981) is a well-established general health measure that provides comprehensive clinical information across multiple domains, but remains limited due to its substantial length and questionable factor structure. While several short-form adaptations of the SIP have been developed, these measures are either not suitable for use in chronic pain or sacrifice its broad scope in favor of a greatly reduced number of items. Given the prevalence and difficulty in managing chronic pain, there is still a need for a psychometrically sound, chronic pain-specific measure that provides broad and robust clinical information while minimizing patient burden. The present study conducted a secondary analysis on assessment data of adults with chronic pain (N=723) presenting for treatment at an

interdisciplinary rehabilitation program to explore the factor structure of the SIP and develop a short form specifically designed for use in chronic pain (SIP for Chronic Pain, SIP-CP). Items on each of the 12 original SIP subscales were evaluated for inclusion in the SIP-CP using a 2-PL item response theory (IRT) model, in which items were removed individually with subsequent evaluation of the model using multiple indices of fit. The final 42-item SIP-CP demonstrated acceptable convergent and divergent validity and was able to account for a similar amount of the variance in a number of relevant clinical characteristics as both the original SIP and a non-pain-specific shortened version, the SIP68. The SIP-CP is a psychometrically supported form of the SIP that appears to provide similarly robust clinical information with substantially reduced burden in patients seeking treatment for chronic pain.

*Keywords: chronic pain, assessment, quality of life*

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## Chapter 1

### Introduction

Chronic pain is a complex and debilitating condition affecting an estimated 100 million adults in the U.S., more than the total affected by heart disease, cancer, and diabetes combined (Gaskin & Richard, 2012). In contrast to acute pain, generally considered to be an adaptive mechanism that serves as a warning for injury or infection, chronic pain persists beyond the expected time for healing (typically three to six months) and does not appear to serve any adaptive function (Ashburn & Staats, 1999; Institute of Medicine Committee on Advancing Pain Research Care and Education, 2011). Further, the impact of chronic pain is severe and is prone to affect all areas of one's life (Gatchel, Peng, Peters, Fuchs, & Turk, 2007).

More than just a biological phenomenon, chronic pain is a notably subjective experience (Mackintosh & Elson, 2008), often leading to impaired physical, emotional, social, and cognitive functioning (Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006; Gaskin & Richard, 2012; Gatchel et al., 2007). Persistent pain may interfere with one's ability to work and perform other daily tasks of living (Breivik et al., 2006; Elliott, Smith, Hannaford, Smith, & Chambers, 2002; Smith et al., 2001). Sleep disturbances and fatigue are common (Ashburn & Staats, 1999; Fredheim et al., 2008; McCracken & Iverson, 2002), and the combination of decreased energy and reduced activity level may result in chronic pain patients giving up other activities they enjoy in order to avoid pain (Andrews, Strong, & Meredith, 2012). Increased stress, anxiety, and depression are also frequently reported in patients with chronic pain (Ashburn & Staats, 1999; Gatchel et al., 2007; Linton & Götestam, 2010; McWilliams, Cox, & Enns, 2003), which may further

contribute to difficulty maintaining relationships with family and friends (Breivik et al., 2006; Seers & Friedli, 1996; Turk, 2002b). All of these factors may, in turn, contribute to a reduced quality of life (Breivik et al., 2006; Dysvik, Lindstrøm, Eikeland, & Natvig, 2004; Gaskin & Richard, 2012). For example, in a 2008 study, Fredheim and colleagues found that patients with chronic non-cancer pain reported worse quality of life than patients with terminal cancer receiving palliative care (Fredheim et al., 2008). There are economic and societal implications of chronic pain as well, with a recent conservative estimate of direct and indirect costs at \$560-635 billion annually in the U.S. (Gaskin & Richard, 2012).

The complexities and individual differences in chronic pain make it particularly difficult to treat. Mechanisms of the condition remain unclear, and often chronic pain occurs without any obvious cause (Mackintosh & Elson, 2008). Despite a wide array of pharmacological, surgical, physical, and psychological interventions, their effectiveness is limited, and complete pain relief remains a rare outcome (Andersson, 2004; Carr & Mann, 2000; Elliott et al., 2002; Turk, 2002a). Multiple attempts at treatment are common, as providers have no means of predicting how well a particular treatment will work for a given patient (Mackintosh & Elson, 2008; Turk, 2002a). As a result, treatment goals are likely to focus on improved functioning rather than the elimination of pain (Moore, 2012), with the treatment process involving a long-term collaboration between the chronic pain patient and their providers (Allcock, Elkan, & Williams, 2007; Mackintosh, 2005).

The perception, course, and overall effectiveness of treatment is dependent on a number of overlapping and interacting biological, psychological, environmental, and

social factors (Gatchel et al., 2007; Turk & Theodore, 2010). For example, the emotional experience of pain may become increasingly more important over time as failed treatment attempts may cause patients to become discouraged, lose faith in treatment and their providers, or feel that their symptoms are not being taken seriously (Allcock et al., 2007; Gatchel et al., 2007; Mackintosh & Elson, 2008). As such, treatment goals of improved functioning are likely to include affective, cognitive, and social domains. However, there is still a need for interdisciplinary approaches to better understand and address the complex relationships among the many factors that may contribute to chronic pain in an individual over time (Institute of Medicine Committee on Advancing Pain Research Care and Education, 2011).

Assessments play a key role in treatment targeting improved functioning, though not all measures are equally useful (Amris, Wæhrens, Jespersen, Bliddal, & Danneskiold-Samsøe, 2011; Breivik et al., 2008; Mackintosh, 2005; Mackintosh & Elson, 2008). Due to the multidimensional nature of chronic pain, it is important that assessments are thorough and evaluate functioning across physical, psychological, and social domains (Allcock et al., 2007; Breivik et al., 2008; Mackintosh & Elson, 2008). Initial assessments serve as an index of severity by indicating the areas and extent to which pain interferes with daily life, which provide a baseline level of functioning and aid in determining an appropriate course of treatment (Amris et al., 2011; Mackintosh & Elson, 2008). Basal measures also allow providers to better understand the patient's perception of their pain, quality of life, and expectations for treatment (Fredheim et al., 2008; Mackintosh & Elson, 2008). Follow-up assessments track patient progress and treatment efficacy over time (Amris et al., 2011; Breivik et al., 2008; Mackintosh, 2005;

Mackintosh & Elson, 2008), and can be used to promote rapport and better communication in the patient-provider relationship (Mackintosh & Elson, 2008). Since assessments are intended to occur throughout the course of treatment, it is necessary to balance patient burden (time and effort required) with the comprehensiveness of the assessment in order to best serve the needs of the patient (Turk et al., 2003).

One of the most well-established general health-related quality of life measures is the Sickness Impact Profile, or SIP (Bergner et al., 1981). The SIP was designed to assess how a wide range of illnesses affect daily activities in physical, psychological, and social domains (Bergner, 1993; Bergner et al., 1981; Bergner, Bobbitt, Kressel, et al., 1976; Bergner, Bobbitt, Pollard, Martin, & Gilson, 1976). By measuring changes in behavior due to illness, it has been argued that the SIP is more objective than instruments focused on emotional states (Bergner, Bobbitt, Kressel, et al., 1976), and it has been shown to be sensitive enough to detect small changes in an individual's self-rated functioning over time (Bergner et al., 1981; Deyo & Inui, 1984).

The development of the SIP has been well-documented. In brief, it was initially tested and standardized on a large, diverse sample of patients with a wide range of health problems (Bergner, 1993; Bergner et al., 1981; Bergner, Bobbitt, Pollard, et al., 1976). The SIP has been shown to work well in individuals who are highly impaired (Andresen & Meyers, 2000), and is often used as a "gold standard" against which other health status measures are evaluated (McDowell, 2006). In the context of chronic pain, individuals are asked to identify which items apply to them that day as a result of their pain. Completion of the 136-item measure yields an overall score indicating total disability, three dimension scores assessing Physical, Psychosocial, and Independence/Other disability,

and 12 subscale scores including Ambulation, Mobility, Body Care & Movement, Communication, Alertness Behavior, Emotional Behavior, Social Interaction, Sleep & Rest, Eating, Work, Home Management, and Recreation & Pastimes (Bergner, 1993; Bergner et al., 1981). All scores are calculated on the same 0 to 1 scale representing the extent of disability or dysfunction in that domain, with higher scores indicating greater disability due to health concerns. To date, few alternative measures are able to provide health profiles as thorough and informative as the SIP.

The SIP also has its share of weaknesses. Although the SIP provides a very comprehensive assessment of general health status in comparison to other measures, its behavioral dysfunction approach does not assess any positive aspects of health such as acceptance or self-efficacy (Andresen & Meyers, 2000). The response format of the SIP, which instructs participants to leave statements that do not apply to them blank, makes it difficult to differentiate missing data from unendorsed items (Andresen & Meyers, 2000; Busija et al., 2011). Ceiling effects have also been observed in patients with low to moderate levels of functional impairment, limiting the instrument's sensitivity to change in these individuals (Andresen & Meyers, 2000; Busija et al., 2011).

The SIP has been most frequently criticized, however, for its length, making it less acceptable to patients than briefer alternative measures (Busija et al., 2011; Damiano, 1996; De Bruin, Diederiks, De Witte, Stevens, & Philipsen, 1997; Deyo, Inui, Leininger, & Overman, 1983; Lipsett et al., 2000; Read, Quinn, & Hoefler, 1987). Previous research has attempted to address this criticism through the development of shortened forms to minimize patient burden (De Bruin, Buys, De Witte, & Diederiks, 1994; Gerety et al., 1994; Roland & Fairbank, 2000; Roland & Morris, 1983; Sullivan, Ahlmen, Bjelle, &

Karlsson, 1993; Van Straten et al., 1997). However, despite the focus on short-form adaptations, no study has been able to replicate the 12-factor structure of the original SIP (De Bruin, Buys, et al., 1994; Lindeboom et al., 2004; Nanda, McLendon, Andresen, & Armbrecht, 2003), undermining the validity of the measure's subscales. With no statistical support for the factor structure of the SIP, the psychometric properties are inadequate and present another limitation to its usage.

In spite of these limitations, the SIP remains widely used, mostly likely due to the fact that it provides robust clinical information in comparison to alternative measures. Still, the majority of abbreviated versions of the SIP are not suitable for chronic pain patients because they are either specific to other chronic health conditions (Sullivan et al., 1993; Van Straten et al., 1997), designed for use in a nursing home population (Gerety et al., 1994), or reduced to capture only the domain of physical functioning as in the Roland Morris scale for back pain (Roland & Morris, 1983).

A 68-item version of the SIP, the SIP68 (De Bruin, Buys, et al., 1994), remains broad in scope and suitable for a chronic pain population, but has not been widely tested and faces the same validity issues as the original SIP with an inability to replicate its (revised) factor structure (Lindeboom et al., 2004; Nanda et al., 2003). Recognizing that the SIP68 may not contain items vital to certain diagnostic groups, researchers have identified a need for additional disease-specific adaptations of the SIP (Lindeboom et al., 2004).

Given the widespread prevalence of chronic pain, the recognized importance of assessment in managing this condition, and the combination of strengths and limitations faced by the SIP and its variants, it is surprising that no further attempts have been made

to refine the SIP for a chronic pain population. The purpose of this study, therefore, was to explore the factor structure of the original SIP in patients with chronic pain in order to develop a shortened form specific for this condition that maintains the comprehensiveness of assessment across domains while minimizing patient burden, and to compare the theoretical structure of the SIP with the factor structure supported through statistical methodology in a treatment-seeking chronic pain population.

### **Initial Development of the SIP**

Further attempts to refine the SIP would be remiss without an understanding of how the measure was originally developed. Creation of the SIP began in 1972 with the purpose of developing a behaviorally-based outcome measure for health care that was unbiased and sensitive to change, with final revisions completed in 1981 (Bergner et al., 1981; Bergner, Bobbitt, Kressel, et al., 1976; Bergner, Bobbitt, Pollard, et al., 1976; Gilson et al., 1975). Items for the SIP were intended to reflect how both patients and healthcare professionals perceived the impact of sickness, and were selected from responses to open-ended survey questions completed by over 1,000 health care professionals, patients, caregivers, and healthy controls along with a careful review of the literature (Gilson et al., 1975). Statements regarding the use of health care services were considered potential confounds (as artifacts of the health care system) and consequently excluded (Bergner, Bobbitt, Kressel, et al., 1976). Majority agreement in a team of five researchers reduced an initial 1,250 items to 312 unique statements grouped into 14 categories based on shared activities, which were then put into a standardized structured interview instrument and pilot tested in a sample of roughly 500 participants in a 1973 field trial (Bergner et al., 1981; Bergner, Bobbitt, Kressel, et al., 1976; Gilson et al.,

1975). A group of 25 judges (physicians, nursing, medical, and health services administration students) implemented a successive-interval scaling procedure by independently ranking the severity of dysfunction of each item to further evaluate the construct of behavioral dysfunction and provide a basis for scoring (Gilson et al., 1975). With high agreement between judges and stable mean values across both an 11-point and 15-point scale, the average value for extreme items served as common endpoints and the remaining item values were mathematically assigned (Bergner, Bobbitt, Kressel, et al., 1976; Gilson et al., 1975).

Reliability of the scaling procedure was tested using four groups of 25 new judges, who each rated 50 participant responses from the field trial independently on the same 11-point and 15-point scales; agreement was generally high for both individual items and total profile score (Carter, Bobbitt, Bergner, & Gilson, 1976; Gilson et al., 1975). Items with a 95 percent confidence interval greater than the mean standard deviation of two scale points were removed, yielding 284 reliably-scaled items (Bergner, Bobbitt, Kressel, et al., 1976; Gilson et al., 1975). Four methods of scoring were evaluated: a mean of the scaled dysfunction weights of endorsed items, a mean of the squared scale values of endorsed items (which increased the relative weight of items on the high end of the scale), a percentage of total possible dysfunction, and a profile score or measure of frequency distribution based on the number of endorsed items within one of four scale-point groupings. All four methods were deemed sufficient, though correlation coefficients were highest ( $r > .85$ ) for the percentage and profile scoring methods (Bergner, Bobbitt, Kressel, et al., 1976; Gilson et al., 1975). Item analysis from data in the 1973 and 1974 field trials reduced the length of the SIP to 189 items, which



was further refined to the current 136 items following the 1976 field trial (Bergner et al., 1981). Categories of the SIP were also re-evaluated with this data to eliminate redundancy, at which point high inter-category correlations led to the consolidation of Movement of the Body and Personal Hygiene into Body Care & Movement. Analysis of category scores did not support the merging of Social Interaction and Family Interaction, but subsequent item analysis provided enough evidence to combine the two into a Social Interaction subscale. The final revision of the SIP contained 136 items from 12 categories, which can be scored as 12 separate subscales, as Physical, Psychosocial, and Independence/Other dimension scores, or as a total disability score reflecting overall health dysfunction (Bergner et al., 1981).

From a psychometric perspective, the SIP has demonstrated good specificity with the ability to detect clinically and statistically significant changes in self-rated functioning, with acceptable content and criterion validity (Andresen & Meyers, 2000; Bergner, 1993; Bergner et al., 1981; Bergner, Bobbitt, Pollard, et al., 1976; Brooks, Jordan, Divine, Smith, & Neelon, 1990; De Bruin, De Witte, Stevens, & Diederiks, 1992; De Bruin et al., 1997; Follick, Smith, & Ahern, 1985; Katz, Larson, Phillips, Fossel, & Liang, 1992; Liang, Fossel, & Larson, 1990; Pollard, Bobbitt, Bergner, Martin, & Gilson, 1976). Failure to replicate the factor structure of the subscales underlying the SIP, however (De Bruin, Diederiks, De Witte, Stevens, & Philipsen, 1994; Lindeboom et al., 2004; Nanda et al., 2003), indicates construct validity remains problematic. Short-form adaptations of the SIP had an opportunity to address this issue, but there is little evidence supporting the factor structure of these revised measures. Furthermore, short-form adaptations of the SIP have yet to adequately address the assessment needs of chronic

pain patients. At present, the only abbreviated version of the SIP specific to chronic pain is the Roland Morris Disability Questionnaire (Roland & Fairbank, 2000; Roland & Morris, 1983), which covers only a limited range of activities in the physical domain and does not assess psychological or social functioning. The SIP68 (De Bruin, Buys, et al., 1994) provides a broad assessment of functioning across physical, psychological, and social domains and has an item pool that was developed using statistical methods, although the stability of its factor structure (Nanda et al., 2003) and utility in a chronic pain population remain unclear.

Understanding the development of the SIP68 may help guide efforts to refine the SIP for a chronic pain population. The SIP68 was derived from SIP data of 2,527 participants in 10 diagnostic groups from the Netherlands, with work category items dropped due to missing data and differences between Dutch and U.S. systems (De Bruin, Buys, et al., 1994; De Bruin, Diederiks, et al., 1994). Scores with and without the subjectively determined item weights were highly correlated (.94-.99), so subsequent analyses used the number of endorsed items rather than item weights without fear of introducing additional bias (De Bruin, Diederiks, et al., 1994). An initial principal components analysis (PCA) with varimax rotation produced 36 distinct factors which bore no resemblance to the categories of the SIP and did not follow any logical constructs of health-related dysfunction. Restricting the number of extracted factors to match the structure of the SIP did not resolve this issue, so an additional 19 items with skewed response patterns (applying to less than 10% or greater than 90% of a diagnostic subgroup) were removed. A PCA was repeated on the remaining 108 statements which produced 29 produced factors that were then reduced to an interpretable six factor model

using content analysis and a minimal factor variance criterion of 2%. Items with factor loadings below 0.4 were removed and the PCA was repeated with the remaining 73 items, resulting in a loss of five additional statements due to factor loadings less than 0.4. Fearing that further PCA runs would compromise the robustness of the abbreviated measure, the remaining 68 items formed the final SIP68 with subscale categories of Somatic Autonomy, Mobility Control, Psychological Autonomy and Communication, Social Behavior, Emotional Stability, and Mobility Range (De Bruin, Diederiks, et al., 1994).

This six-factor structure was then tested in a PCA comparing a separate subset of patients to compare scores of the total population with scores in four diagnostic subgroups: locomotor complaints, back and neck-complaints, cerebral problems, and internal and neuromuscular diseases. Cattell's salient similarity index (Cattell, Balcar, Horn, & Nesselroade, 1969) indicated the same factor solution was found within all four diagnostic subgroups, with an acceptable Cronbach's  $\alpha$  for each of the six factors, ranging from 0.72 to 0.85 (De Bruin, Diederiks, et al., 1994). Factor correlations ranged between 0.18 and 0.54 with a PCA for second order factors producing a two-dimensional structure similar to the original SIP: a Physical dimension with Somatic Autonomy, Mobility Control, Social Behavior, and Mobility Range subscale loadings greater than 0.4 and a Psychosocial dimension with Psychological Autonomy and Communication, Social Behavior, and Emotional Stability factor loadings greater than 0.4. Regression formulas were able to predict the total score on the original SIP from the total SIP68 score with an  $R^2$  of .94 and from the six subscales of the SIP68 with an  $R^2$  of .96, indicating there is little data loss between the 136-item and 68-item versions of the SIP (De Bruin,

Diederiks, et al., 1994).

Completion of the SIP68 produces a total health dysfunction score, two dimension scores (Physical and Psychosocial), and six subscale scores (Somatic Autonomy, Mobility Control, Psychological Autonomy and Communication, Social Behavior, Emotional Stability, Mobility Range). With no item weights, scores range from 0 to 68, with higher scores still indicating greater levels of health-related dysfunction. Strengths of the SIP68 include its suitability for use with a wide range of diagnoses, improved acceptability due to shortened length, and a more statistically sound factor structure than the original SIP (De Bruin, Buys, et al., 1994; De Bruin, Diederiks, et al., 1994; De Bruin et al., 1997; Post, de Bruin, de Witte, & Schrijvers, 1996). The SIP68 has demonstrated acceptable internal consistency and criterion validity (De Bruin, Buys, et al., 1994; De Bruin, Diederiks, et al., 1994; De Bruin et al., 1997; Nanda et al., 2003; Post et al., 1996) as well as good test-retest reliability (De Bruin, Buys, et al., 1994; Nanda et al., 2003), sensitivity to change (De Bruin et al., 1997), and strong correlations with the original SIP dimension scores (De Bruin, Diederiks, et al., 1994; Nanda et al., 2003).

As with the original SIP, the SIP68 also has its share of weaknesses. Due to changes in the scoring procedure, scores on the original SIP cannot be directly compared to scores on the SIP68, nor can dimension or subscale scores on the SIP68 be compared to each other since the total number of items on each scale is not consistent (De Bruin et al., 1997; Nanda et al., 2003). Very little data on the performance of the SIP68 is available aside from what the scale authors have published. To date, only one study has attempted to replicate the SIP68 factor structure and assess its psychometric properties, in which ceiling effects were observed on a third of the subscales of the original SIP

(Emotional Behavior, Alertness, Communication, and Eating) and on half of the SIP68 subscales (Psychological Autonomy & Communication, Emotional Stability, and Mobility Range), indicating skewed responses may remain problematic (Nanda et al., 2003). Furthermore, despite using the same criteria reported in the development of the SIP68, Nanda and colleagues PCA was unable to fully replicate the factor structure of either the SIP or the SIP68. By constraining results to 6 factors, the authors were able to produce a measure that included 65 of the items on the SIP68, but retained an additional 36 items, many of which appeared on the original SIP subscale of Recreation & Pastimes (Nanda et al., 2003). As such, further research is needed to determine whether the SIP68 is appropriate for patients with chronic pain or if an alternative modification of the SIP may be better suited for this population.

### **Aims of the Present Study**

To summarize, the SIP remains widely used in spite of its flaws because the clinical information it provides is unmatched by alternative measures. Attempts to refine the SIP have yet to produce a measure that adequately addresses length and factor structure concerns, is suitable for use in chronic pain patients, and retains the robust information of the original measure. Given the prevalence, complexity, and potential consequences associated with chronic pain, there is a clear need for the SIP to be further refined for use in this patient population. The current study sought to address this need by exploring the factor structure of the SIP in a large sample of chronic pain patients and utilized item response theory to guide the development of a shortened-form of the SIP able to meet the multifaceted needs of providers and patients attempting to manage chronic pain. The aim was to construct and evaluate a revised measure, the SIP - Chronic

Pain (SIP-CP) that retained as few items as possible without compromising the broad scope and comprehensiveness of the original SIP. In addition, a series of follow-up correlation and regression analyses were performed to evaluate the convergent and divergent validity of the SIP-CP in relation to other aspects of patient functioning, including pain intensity, depression, pain-related anxiety, acceptance of pain, and frequency of pain-related medical appointments. Cronbach's alpha and confirmatory factor analysis were also utilized to assess how well the data fit the final SIP-CP.

## Chapter 2

### Methods

#### **Participants**

The present study conducted a secondary analysis of assessment data from adults presenting for treatment at two interdisciplinary pain treatment centers in the United Kingdom (UK) between 2005 and 2012 (N=723 patients). Baseline assessment data was collected from all participants during an intake interview. Descriptive statistics for the sample are shown in Table 1.

#### **Measures**

**Demographic and clinical information.** Demographic variables collected included participant age, sex, years of education, employment status, and ethnic/racial background. Pain-related clinical data included duration of pain in months, location(s) of pain, and the number of medical visits over the past six months related to pain. Average pain intensity over the past week was also assessed on a 0 (no pain) to 10 (maximal pain possible) numeric rating scale. Participants' total number of classes of analgesic medications (i.e., opioids, NSAIDS, tricyclic antidepressants, muscle relaxants, sedatives, anticonvulsants, selective serotonin reuptake inhibitors, over-the-counter analgesics) taken for pain was also calculated.

**Sickness Impact Profile (SIP,** see Appendix A; Bergner et al., 1981). The SIP consists of 136 weighted yes/no items which assess health-related dysfunction. Patients are asked to indicate which items apply to them on a given day and are related to their current health. As noted, completion of the SIP yields an overall (total) score, three dimension scores (Physical, Psychosocial, and Independence/Other disability), and 12

subscale scores (Sleep & Rest, Emotional Behavior, Body Care & Movement, Household Management, Mobility, Social Interaction, Ambulation, Alertness Behavior, Communication, Work, Recreation & Pastimes, and Eating). Scores are calculated by dividing the sum of the scale values for endorsed items by the maximum dysfunction score. All resulting scores (total, dimension, and subscale scores) range from 0 to 1, with higher scores indicating poorer health.

**Beck Depression Inventory-II** (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is a widely-used 21-item measure of depression severity based on criteria from the Diagnostic and Statistical Manual of Mental Disorders-fourth edition (DSM-IV). Each item contains four statements increasing in severity scored on a 0-3 scale; total summary scores range from 0 to 63 with larger values indicating more severe depressive symptoms. The BDI-II has demonstrated good convergent and discriminant validity with strong internal consistency and test-retest reliability. Notably, the program changed measures of depression midway through the study, so BDI-II data was only available for a smaller subset of the sample (n=355). Cronbach's alpha for the BDI-II in this sample was .876.

**British Columbia Major Depression Inventory** (BCMDI; Iverson & Remick, 2004). The BCMDI is a 20-item index of depression based on DSM-IV criteria for major depressive disorder. Symptom severity over the last two weeks is assessed through 16 items rated on a 5-point Likert scale, with 1 indicating a very mild problem and 5 indicating a very severe problem. Four items assess the impact of depressive symptoms on work or school, family, and social activities. Symptom summary scores of 9 or less are considered within the normal range, The BCMDI has demonstrated adequate internal



consistency, test-retest reliability, and good sensitivity and specificity for a diagnosis of major depressive disorder. Due to the program changing depression assessments midway through the study, BCMDI data was only available for a subset of the sample (n=358). Cronbach's alpha for the BCMDI in this sample was .857.

**Pain Anxiety Symptoms Scale-20 (PASS-20; McCracken & Dhingra, 2002).**

The PASS-20 assesses fear, anxiety, and avoidance responses specific to pain. This 20-item measure is a shortened form of the PASS with items rated on a frequency scale from 0 (never) to 5 (always). The PASS-20 is strongly correlated with the original 40-item PASS and other measures of functioning and has demonstrated strong internal consistency and reliability with good predictive and construct validity (McCracken & Dhingra, 2002; Roelofs et al., 2004). Cronbach's alpha for the PASS-20 total score was .853 in this sample.

**Chronic Pain Acceptance Questionnaire (CPAQ; McCracken, Vowles, &**

Eccleston, 2004). The CPAQ is a 20-item measure of pain-related acceptance. Items are rated on a 7-point Likert scale of how true the statement is with respect to their typical responses to pain (never true to always true), with higher scores indicating greater acceptance. Completion of the CPAQ yields a total score and two subscale scores: Activity Engagement, reflecting the pursuit of life activities with the continued presence of pain, and Pain Willingness, the extent to which one is engaged in efforts to avoid or control pain. Both total and subscale scores are significantly correlated with measures of physical and emotional functioning and have demonstrated acceptable internal consistency and test-retest reliability (McCracken & Eccleston, 2005; McCracken et al., 2004). Cronbach's alpha for the CPAQ total score was .728 for this sample.

## **Analytic Approach**

The initial plan was to divide the assessment database randomly in half, using the first half for an exploratory factor analysis (EFA) to examine the factor structure of all 136 SIP items and explore the removal of items endorsed with low frequency or demonstrating a bivariate frequency distribution, and the latter half with item response theory (IRT) to develop the shortened SIP for chronic pain. Consistent with previous literature, however, the EFA was unable to replicate the original structure of the SIP, even when requiring the number of factors to be consistent with the number of SIP subscales (12) or dimensions (3). As a result, it was decided to include data from all 723 participants in the next step of the analysis, using IRT to examine the relative usefulness of each item and guide selection of items for a shortened version of the SIP specific for a chronic pain population. Since the item weights of the SIP were arbitrarily determined during its construction by healthcare providers and had no psychometric support, no item weightings were used in these analyses.

Item response theory is a widely-used psychometric method in the area of educational assessment, as it helps address many of the measurement issues presented by classical test theory (Embretson & Reise, 2000). IRT utilizes mathematical models that describe the relationship between an individual's response to an item and their level of the hypothetical latent trait being assessed in probabilistic terms (Hays, Morales, & Reise, 2000), and provides the opportunity to either select items that provide an accurate assessment across the entire range of a trait or items that provide maximum discriminatory value surrounding a critical range of a trait (e.g., a clinical cutoff score). In the present study, IRT aided in the selection of content to eliminate through the

identification of items that weren't providing any significant information about the trait of interest (i.e., disability and dysfunction associated with chronic pain) and helped identify items that should be kept in order to provide an accurate assessment across a broad range of disability and dysfunction in chronic pain. Notable advantages of using IRT over classical test theory (CTT) include the ability to estimate a trait of interest with fewer items and a well-established framework for assessments with greater flexibility in use of statistics since measurements are based on items rather than the sample (Hays et al., 2000).

A two-parameter logistic IRT model provided estimates of two independent functions for each item: difficulty and the discrimination value (see Figure 1 for a conceptual example). The item difficulty parameter, represented by  $\theta$  on the x-axis, is the amount of the latent trait needed to have a .5 probability of endorsing the item. Thus, "easier" items are more likely to be endorsed and appear on toward the left side of the trait scale, while "harder" items are less likely to be endorsed and appear on the right side of the trait scale. The discrimination parameter,  $\alpha$ , is a measure of how strongly the item is related to the underlying latent trait and is represented by the slope of the curve. Steeper slopes indicate better differentiation around their location in which small changes in the level of latent trait correspond with large changes in the probability of endorsing the item. A straight horizontal line indicates the item provides no discrimination or is undefined, while a straight vertical line indicates perfect discrimination just above and below that point, but no ability to distinguish between those with levels of the latent trait further above or below it. Examples of differences in item difficulty and discrimination are shown in Figure 2.

The difficulty and discrimination for each item is graphically represented in an item characteristic curve (ICC), a non-linear regression line representing the likelihood of endorsing that particular item as a function of the underlying trait (i.e., disability due to chronic pain in the case of the present study). Item characteristic curves for dichotomous items like those on the SIP form an S-shaped curve; in the center of this curve, small changes in the level of the underlying trait are associated with large changes in the probability of endorsing that item (Embretson & Reise, 2000). The exact shape and location of the S-shaped curve for each item depends on the estimated difficulty and discrimination parameters; reverse S-shaped curves indicate negative discrimination and suggest something is wrong with that item. Items on subscales were removed individually based on manual inspection of ICCs with evaluation of subsequent changes to model fit. Because ICCs for all items on a subscale are a function of how they work together (and not just the sum of individual ICCs), subscale ICCs were re-evaluated after each step in the model reduction process.

Fit was initially evaluated using chi-square analyses, with non-significant values indicating appropriate model fit. However, since the significance of  $X^2$  model fit tends to increase with larger sample sizes, root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) fit indices were also examined, with efforts to maintain significance on all three of these indices whenever possible. For RMSEA, good fit was defined as a test statistic  $<.05$ , with values  $<.08$  equating to marginal fit (Bryne, 2001). Good fit for CFI and TLI was defined by a test statistic  $>.95$ , with adequate fit attained by values of  $.90$  or larger (Hu & Bentler, 1999). Following the removal of all poorly functioning items as demonstrated by model fit

indices and visual inspection of ICCs, chi-square difference tests were conducted to determine whether the removal of additional items significantly improved model fit across additional iterations of the subscale. For instances in which two items shared the same ICC characteristics (suggesting either could be removed), items were evaluated for overlap and uniqueness relative to other items and clinical relevance for patients with chronic pain and retained or removed accordingly.

This procedure was followed for each of the 12 original subscales of the SIP. All retained items formed the total score; dimension scores consisted of the items retained on their corresponding subscales: the Physical dimension score consisted of retained items on Body Care & Movement, Mobility, and Ambulation subscales, the Psychosocial dimension score contained all retained items on Communication, Alertness Behavior, Emotional Behavior, and Social Interaction subscales, and the Independence/Other dimension score contained all retained items on Sleep & Rest, Household Management, Work, Recreation & Pastimes, and Eating subscales.

Following the selection of the items, examination of correlation coefficients with the original SIP and other clinical measures (depression on the BDI and BCMDI, pain anxiety on the PASS, pain acceptance on the CPAQ, number of classes of pain medication, and number of medical visits related to pain over the last six months) were examined to assess convergent and divergent validity of the newly constructed SIP-CP. Finally, a series of linear regressions was performed to examine differences in the amount of variance accounted for by the original SIP, the SIP68, and the SIP-CP. All three measures were tested as predictors of depression, pain-related anxiety, and acceptance of pain while controlling for age, sex, ethnicity, and pain duration. To account for the

number of analyses performed, significant p-values were constrained to values  $<.001$ .

All analyses were performed using Mplus software (Muthén & Muthén, 2012).

## Chapter 3

### Results

Clinical characteristics of the sample are shown in Table 2. All distributions appeared normal and non-kurtotic. Items retained for the initial SIP-CP are described below.

#### **Revised SIP Subscales**

##### **Physical Dimension Subscales**

**Body Care & Movement Subscale.** Item characteristic curves for the original 23-item and revised 7-item Body Care & Movement subscale are shown in Figure 3. The nearly horizontal line representing item 12 (“I change positions frequently”) indicates particularly poor discrimination and thus was the first item to be removed. As shown in Table 3, the final 7-item Body Care & Movement subscale for the SIP-CP substantially reduced the number of items while retaining good model fit on RMSEA, CFI, and TLI indices.

**Mobility Subscale.** Item characteristic curves for the original 10-item and revised 5-item Mobility subscale are shown in Figure 4. As shown in Table 4, the final 5-item Mobility subscale for the SIP-CP substantially reduced the number of items while retaining good model fit on  $\chi^2$ , RMSEA, CFI, and TLI indices.

**Ambulation Subscale.** Item characteristic curves for the original 12-item and revised 4-item Ambulation subscale are shown in Figure 5. Reverse S-shaped discrimination curves indicate that items 5 (“I get around in a wheelchair”), 6 (“I do not walk at all”), and 10 (“I do not use stairs at all”) were problematic and thus first to be removed. As shown in Table 6, the final 4-item Ambulation subscale for the SIP-CP

substantially reduced the number of items while retaining good model fit on  $X^2$ , RMSEA, CFI, and TLI indices.

**Overall Physical Dimension.** The total number of items included in the Physical dimension score was reduced from 45 to 16. Overall model fit statistics for the SIP and SIP-CP subscales comprising the Physical dimension score (Body Care & Movement, Mobility, and Ambulation) are listed in Table 6.

### **Psychosocial Dimension Subscales**

**Communication Subscale.** Item characteristic curves for the original 9-item and revised 6-item Communication subscale are shown in Figure 6. As shown in Table 7, the final 6-item Communication subscale for the SIP-CP was able to reduce the number of items while retaining good model fit on RMSEA, CFI, and TLI indices.

**Alertness Behavior Subscale.** Item characteristic curves for the original 10-item and revised 7-item Alertness Behavior subscale are shown in Figure 7. Model fit statistics for each step in the reduction process are shown in Table 8. Efforts to reduce the subscale further resulted in poor fit according to the RMSEA index (values  $>.05$ ), so the 7-item version was retained. The final 7-item Alertness Behavior subscale for the SIP-CP was able to reduce the number of items while improving retaining good model fit on RMSEA, CFI, and TLI indices.

**Emotional Behavior Subscale.** Item characteristic curves for the original 9-item and revised 6-item Emotional Behavior subscale are shown in Figure 8. As shown in Table 9, the final 6-item Emotional Behavior subscale for the SIP-CP was able to reduce the number of items while retaining good model fit on RMSEA, CFI, and TLI indices.



**Social Interaction Subscale.** Item characteristic curves for the original 20-item and revised 7-item Social Interaction subscale are shown in Figure 9. As shown in Table 10, the final steps in modeling included various comparisons amongst two similar items, items 15 and 17, which had similar ICCs. Item 15 was eventually retained (“I have frequent outbursts of anger at family members”), as it was judged to be more broadly applicable to chronic pain in comparison to item 17 (“I am paying less attention to the children”). The resulting 7-item Social Interaction subscale was able to significantly reduce the number of items while retaining good model fit on RMSEA, CFI, and TLI indices.

**Overall Psychosocial Dimension.** The total number of items included in the Psychosocial dimension score was reduced from 48 to 26. Model fit statistics for the SIP and SIP-CP subscales comprising the Psychosocial dimension score (Communication, Alertness Behavior, Emotional Behavior, and Social Interaction) are listed in Table 11.

#### **Independence/Other Dimension Subscales**

**Sleep & Rest Subscale.** Item characteristic curves for the original 7-item and revised 4-item Sleep & Rest subscale are shown in Figure 10. The flat horizontal line representing item 1 (“I spend much of the day lying down in order to rest”) indicates the item provided no discrimination and thus was the first to be removed. As shown in Table 12, the final 4-item Sleep & Rest subscale was able to reduce the number of items while retaining good model fit on  $X^2$ , RMSEA, CFI, and TLI indices.

**Home Management Subscale.** Item characteristic curves for the original 10-item Home Management subscale are shown in Figure 11. Note that eight of the ten items are reverse S-shaped curves, indicating problematic items. Without a sufficient

number of good items needed to define the model, the entire Home Management subscale was excluded from the SIP-CP.

**Work Subscale.** Item characteristic curves for the original 9-item Work subscale are shown in Figure 12. Similar to the Home Management subscale, eight of the nine items on the Work subscale were reverse S-shaped curves, indicating problematic items. Without a sufficient number of good items to define the model, the entire Work subscale was excluded from the SIP-CP.

**Recreation & Pastimes Subscale.** Item characteristic curves for the original 8-item and revised 4-item Recreation & Pastimes subscale are shown in Figure 13. Items 4 (“I am not doing any of my usual inactive recreation and pastimes”) and 8 (“I am not doing any of my usual physical recreation or activities”) were nearly horizontal lines indicating they provided very little discrimination and thus were removed first. As shown in Table 13, the final 4-item Recreation & Pastimes subscale was able to reduce the number of items while maintaining good model fit on  $X^2$ , RMSEA, CFI, and TLI indices.

**Eating Subscale.** Item characteristic curves for the original 9-item and revised 4-item Eating subscale are shown in Figure 15. The nearly horizontal line representing item 3 (“I am eating special or different food”) indicated poor discrimination and was the first to be removed. As shown in Table 14, the final 4-item Eating subscale was able to reduce the number of items while retaining good model fit according to  $X^2$ , RMSEA, CFI, and TLI indices.

**Overall Independence/Other Dimension.** The total number of items included on the Independence/Other dimension score was reduced from 43 to 12. As previously

described, the Home Management and Work subscales were ultimately excluded from the SIP-CP due to a lack of good fitting items. Model fit statistics for the SIP and SIP-CP subscales comprising the Independence/Other dimension score (Body Care & Movement, Mobility, and Ambulation) are listed in Table 15 and are further discussed below.

### **Dimension and Total Disability Scores**

After refining each of the 12 original subscales of the SIP, the remaining 54 items were compiled back into the original three dimension scores (Physical, Psychosocial, and Independence/Other disability) and a total score representing overall disability. Model fit was then evaluated for each of these higher order scores. As shown in Table 16, the Physical and Psychosocial dimension score obtained adequate fit according to all three fit indices, with the total score meeting criteria for good fit according to the RMSEA fit index only. The Independence/Other dimension score, by contrast, did not meet any of the requirements for acceptable model fit. Since the items were still supported at a subscale level, further analyses were conducted to determine whether there may be sufficient evidence to retain this content.

### **Comparison of SIP, SIP68, and SIP-CP**

The second aim of this study was to explore performance of the SIP-CP by first examining correlations among the SIP-CP and other clinical measures and comparing the magnitude of these correlations in relation to the original SIP and SIP68. Correlations among scores from the three versions of the SIP were also examined. As shown in Table 17, all three versions of the SIP were strongly correlated with one another for the total score, Physical dimension, and Psychosocial dimension scores. In particular, correlations were in excess of .90 for the SIP-CP in relation to the scores of the original and shortened

versions. The correlation between the SIP and SIP-CP for the Independence/Other dimension was also significant, but notably smaller ( $r=.62$ ). Table 18 shows correlations among the SIP, SIP68, and SIP-CP with aspects of patient functioning, including measures of depression, pain-related anxiety, pain-related acceptance, the number of classes of pain medication taken, and number of pain-related medical visits in the last six months. All correlations at this level were significant.

The next data analytic step involved a series of linear regressions to examine how well the SIP, SIP-CP, and SIP68 were able to statistically predict these clinical characteristics after controlling for differences in participant age, sex, ethnicity, and pain duration. As shown in Table 19, disability scores on the SIP and its variants were able account for 35-55% of the variance in depression, 28-32% of variance in pain-related anxiety, 24-31% of the variance in pain-related acceptance, 6-8% of the variance in the number of pain medication classes taken, and 10-12% of the difference in number of pain-related medical visits over the last six months. Descriptively, the proportion of variance accounted for by the SIP-CP across all regression analyses appeared comparable to both the SIP and SIP68.

Finally, psychometric properties of the SIP-CP were examined. Cronbach's alpha coefficients were calculated for SIP and SIP-CP scores to assess internal consistency and are shown in Table 20. Alpha coefficients larger than .70 are traditionally considered an indicator of adequate internal consistency (Nunnally, 1978). However, since alpha values are a function of the number of test items, it has been suggested that high values ( $>.90$ ) may indicate redundancy and thus indicate that the number of items could be further reduced (Tavakol & Dennick, 2011). Therefore, confirmatory factor analyses were also

conducted to assess how well the data fit the proposed structure of the SIP-CP at the subscale, dimension, and overall levels. Results from these analyses are shown in Table 21. As with the IRT analyses, model fit was primarily evaluated using RMSEA, CFI, and TLI fit indices since  $X^2$  values are frequently significant with larger sample sizes. An additional function of these analyses was to aid in the determination of whether the SIP-CP should include the retained items from the Independence/Other dimension, which were supported at the subscale level but not as a dimension score. Notably, attempts to integrate these supported subscales into Physical and Psychosocial dimensions were unsuccessful. Due to a further lack of psychometric support indicated in these analyses, the Independent/Other dimension score, comprised of the Sleep and Rest, Eating, and Recreation and Pastimes subscales, were all removed from the SIP-CP. This resulted in the final 42 item SIP-CP which provides 7 subscale scores (Body Care & Movement, Mobility, Ambulation, Communication, Alertness Behavior, Emotional Behavior, and Social Interaction), 2 dimension scores (Physical and Psychosocial), and an overall total disability score.

## Chapter 4

### Discussion

The final 42-item SIP-CP demonstrated acceptable convergent and divergent validity and was able to account for a similar amount of the variance in a number of relevant clinical characteristics as both the original SIP and SIP68. These preliminary results support future research using the SIP-CP, as the total disability score, Physical and Psychosocial dimension scores, and seven subscale scores of the SIP-CP were psychometrically supported and able to provide similarly robust clinical information as the original SIP while reducing patient burden in the treatment-seeking chronic pain population.

#### **Use of Item Response Theory**

Previous attempts to shorten the SIP have all relied on classical test theory, a test-centered approach that presumes a linear relationship in which the test score is the sum of a respondent's true score and error score. Item response theory, in contrast, uses nonlinear mathematical models to describe the relationship between the likelihood of endorsing an item and level of the underlying latent trait (Embretson & Reise, 2000). Fundamental assumptions for using IRT include unidimensionality and local independence, which were verified for the current study by examining eigenvalues during exploratory factor analysis. Other assumptions of IRT include monotonicity, which requires that the probability of endorsing an item increases along with increases in the underlying latent trait, and parameter invariance across groups, which allows for the comparing of scores across respondents even if they endorse different items and modeling change over time (Hays et al., 2000). Accordingly, item response theory is

well suited for the selection of items to retain on a measure. Potential difficulties associated with IRT include more stringent assumptions for the data, larger sample size requirements, and increased complexity, with identification of poor items not as straightforward as in classical test theory (Hays et al., 2000). Since these issues were not problematic in the current study, there is no indication that an alternative statistical approach would be more appropriate.

### **Evaluation of Independence/Other Dimension Score**

The goal in the development of the SIP-CP was to create a shortened measure to alleviate patient burden while retaining as much of the breadth and depth of the clinical information captured by the SIP as possible. With the focus on retaining a full range of clinical information, item selection was based on model fit at the subscale level. Good model fits across RMSEA, CFI, and TLI indices were initially obtained for 10 of the 12 subscales in the original SIP, with adequate psychometric support to retain 7 of the 12 original subscales in the final SIP-CP. More specifically, Physical and Psychosocial dimension scores demonstrated adequate model fit according to RMSEA, CFI, and TLI fit indices, while the RMSEA value indicated good model fit for the total disability score. Thus, all items initially retained which comprised the Physical and Psychosocial dimension scores formed the SIP-CP.

Despite good fit for three subscales comprising the Independence/Other dimension score, fit indices failed to support the inclusion of the Independence/Other dimension score. Further supporting the exclusion of this dimension from the final SIP-CP were noticeably lower correlations with clinical characteristics compared to the Physical and Psychosocial dimension scores, and failure for CFA to converge when

including this content at the item to total disability and subscale to dimension levels of analysis. Accordingly, the Independence/Other dimension subscales were removed from the final SIP-CP.

### **Limitations**

There are a number of limitations to consider. Although measurements in item response theory are based on items rather than the sample, there is still a need to ensure that the present sample was heterogeneous enough to be representative of a broader array of chronic pain patients. With regard to the methodology of the current study, since IRT analyses were conducted on all 723 participants after the EFA failed to replicate the factor structure of the original SIP, there was no assessment for differential item functioning across groups. Also, item selection for the SIP-CP was determined by maximizing model fit across multiple fit indices at the subscale level only. Although adequate fit was obtained for the total score and Physical and Psychosocial dimension scores, it remains unclear whether further refinement of items at broader levels of analysis may improve fit at the level of dimension and total SIP-CP disability score. Furthermore, the lack of item weighting in these analyses assumes that all items were equally useful at defining disability in chronic pain. Finally, it is worth noting that this measure was developed in and intended for chronic pain patients actively seeking treatment for their condition. Accordingly, it may not be appropriate for use in individuals with less severe levels of disability.

### **Future Directions**

Performance of the SIP-CP warrants future study to test its validity and clinical utility in chronic pain patients. Testing for parameter invariance by examining



differential item functioning across groups of pain patients (by age, sex, socioeconomic status, pain duration, etc.) would further establish whether the SIP-CP can be applied to the larger chronic pain population. Formal testing of the local independence assumption for dimension and total scores should examine whether there are highly similar or highly correlated items across subscales.

For clinicians and researchers primarily interested in use of the more global dimension and total scores, it may be worthwhile to examine whether model fits can be improved by conducting further item evaluation at these levels of analysis. Such efforts would also likely benefit from examining the test information function (TIF) to evaluate and/or adjust the portion of the trait range for which the SIP-CP best functions. Further efforts to determine and test empirically supported item weights, like those generated through similar IRT methods by Lindeboom and colleagues, may also improve psychometric support for the SIP.

Table 1

*Participant Demographics (N=723)*

	n	%
Female	474	65.7
Caucasian	704	97.5
Marital Status		
Married	455	63
Single	121	16.8
Divorced	97	13.4
Primary Pain Site		
Lower back	346	48
Lower limbs	105	14.6
Full body	84	11.7
Upper shoulder/limb	76	10.5
	Mean	SD
Age	46.40	12.09
Education	12.34	2.48
Pain duration (in months)	128.31	121.18
Average pain intensity during past week	7.16	1.81

Table 2

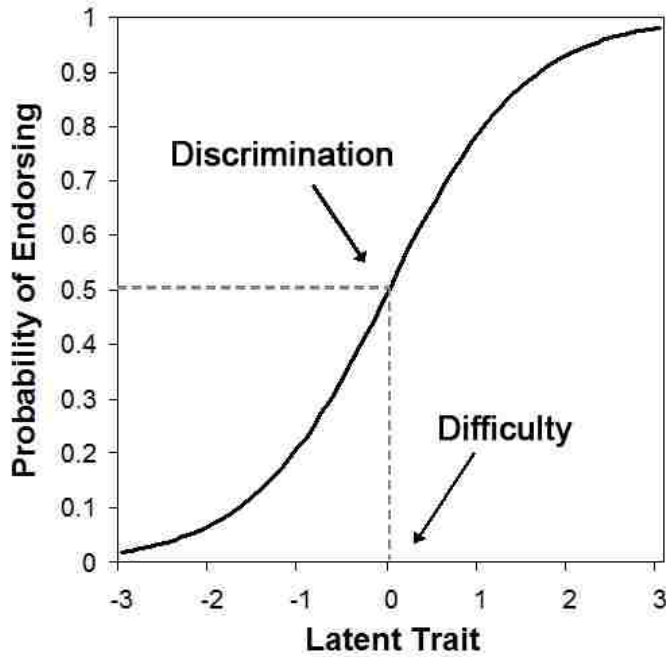
*Clinical Characteristics (N=723)*

	Mean	SD
Classes of pain medication	2.680	1.500
Medical visits for pain in the last 6 months	6.726	7.159
SIP total disability	.265	.128
Physical dimension	.231	.151
Body Care & Movement	.215	.164
Mobility	.228	.202
Ambulation	.273	.171
Psychosocial dimension	.272	.169
Communication	.105	.143
Alertness Behavior	.378	.302
Emotional Behavior	.330	.229
Social interaction	.270	.189
Independence/Other dimension	.299	.114
Sleep & Rest	.261	.174
Home Management	.359	.224
Work	.570	.250
Recreation & Pastimes	.343	.193
Eating	.046	.067
Depression*		
BDI-II (n=355)	20.575	9.891
BCMDI (n=358)	26.879	14.555
Pain-related anxiety (PASS-20)	47.594	19.184
Pain-related acceptance (CPAQ)	47.175	18.764

\*Note. Depression measures changed midway through the study - participants received either the BDI-II or BCMDI, but not both.

Figure 1

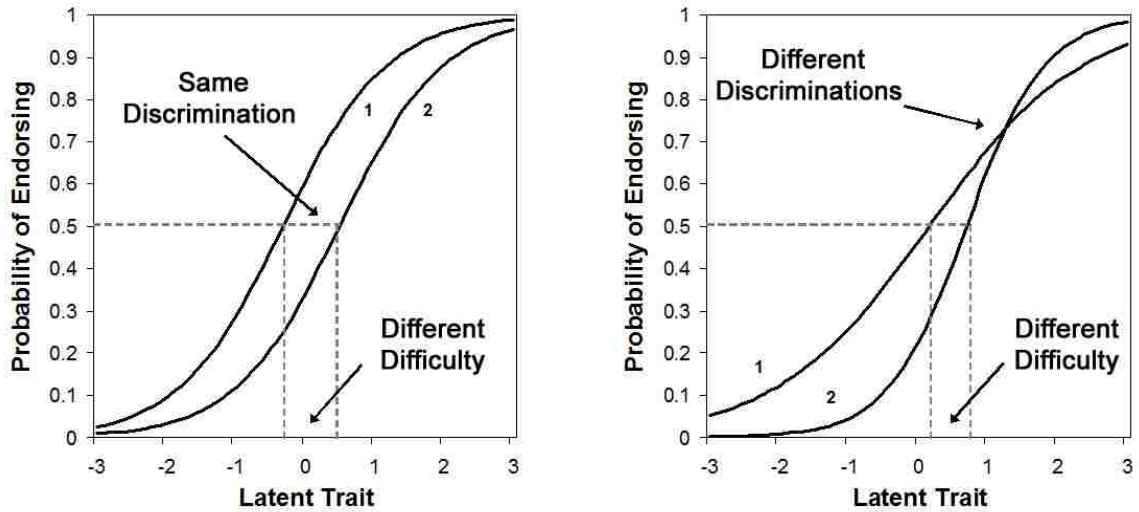
*Parameters of Item Characteristic Curves in 2-PL IRT Model*



Item Characteristic Curves for a 2-PL IRT model contain information regarding item difficulty and discrimination. Difficulty is the location on the x-axis where the probability of endorsing that item is .5. Discrimination is the slope of the curve representing how strongly related the item is to the latent trait at a given location.

Figure 2

*Examples of Parameter Differences in 2-PL Item Characteristic Curves*



*At left:* Items 1 and 2 have the same discrimination because their slopes are identical. They have different difficulty because the location on the x-axis which corresponds to a .5 probability of endorsing the item is at different levels of the latent trait. *At right:* Items 1 and 2 have different discrimination because their slopes are different, difficulty is different because location on x-axis corresponding with .5 likelihood of endorsing the item is at different levels of the latent trait.

Figure 3

*Item Characteristic Curves for SIP and SIP-CP Body Care & Movement Subscale*

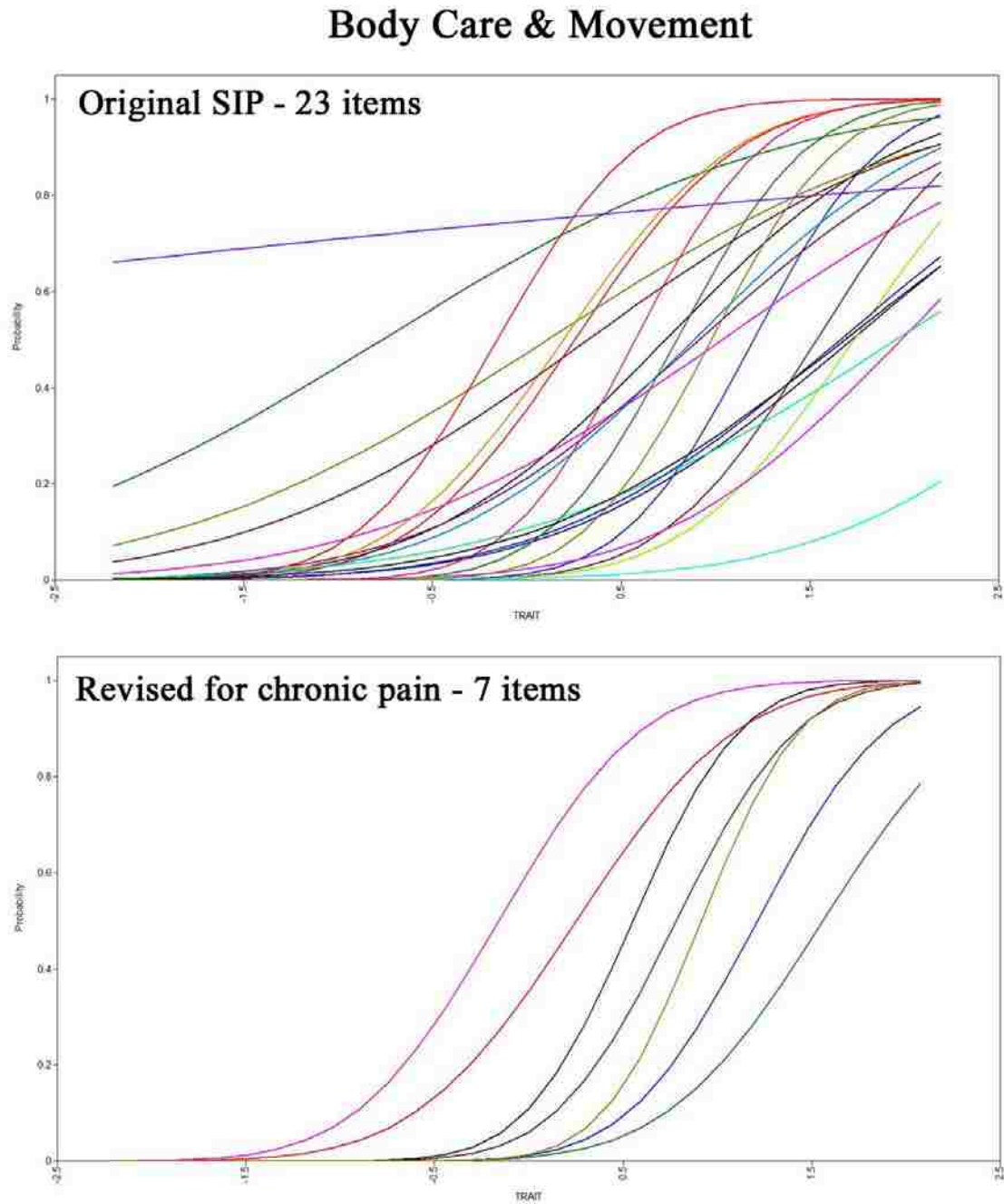


Table 3

*Selection Process for Body Care & Movement Subscale*

Iteration	Original	1	2	3	4	5	6	7	8	9	10	11
Item number & adjustment (+/-)	N/A	-12	-16	-3	-21	-18	-11	+18, +11, -7	-22	-18	-11	-20
X <sup>2</sup>	731.95	679.36	676.45	614.7	511.39	494.45	462.37	403.49	285.1	265.29	229.42	214.49
df	230	209	189	170	152	135	119	135	119	104	90	77
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
RMSEA	.055	.056	.060	.060	.057	.061	.063	.052	.044	.046	.046	.050
CFI	.890	.898	.898	.905	.921	.920	.992	.939	.960	.961	.961	.965
TLI	.869	.887	.886	.893	.911	.909	.911	.931	.955	.954	.954	.958

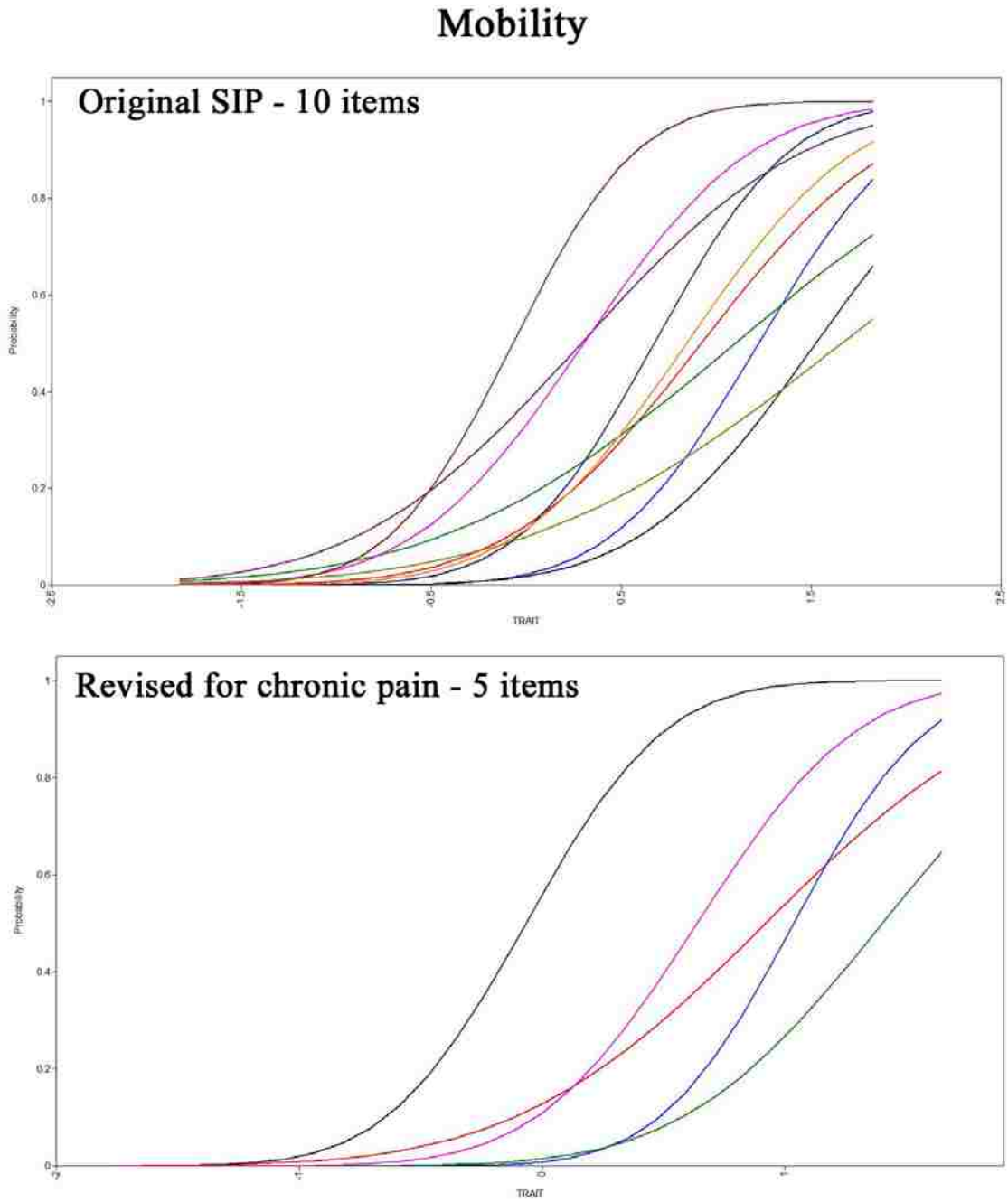
  

Iteration	12	13	14	15	16	17	18	19	20	21	22	23	Final
Item number & adjustment (+/-)	-8	-5	-6	-15	+6, +15, -4	-9	-10	-13	-6	-15	+6, +15, -19	-15	+19
X <sup>2</sup>	207.66	178.84	174.01	90.01	114.09	97.37	60.90	47.42	39.65	27.51	42.08	32.03	36.652
df	65	54	44	35	44	35	27	20	14	9	14	9	14
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	.0002	.0005	.0003	.0012	.0001	.0002	.0008
RMSEA	.055	.057	.064	.047	.047	.050	.042	.044	.050	.053	.053	.060	.047
CFI	.962	.965	.961	.983	.979	.981	.988	.990	.990	.992	.986	.987	.991
TLI	.954	.958	.951	.978	.974	.976	.984	.986	.984	.986	.979	.979	.986

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 4

*Item Characteristic Curves for SIP and SIP-CP Mobility Subscale*



\*Note changes in scale.



Table 4

*Selection Process for Mobility Subscale*

Iteration	Original	1	2	3	4	Final
Item number & adjustment (+/-)	N/A	-7	-9	-10	-3	-5
X <sup>2</sup>	127.107	104.926	80.481	46.603	27.496	9.085
df	35	27	20	14	9	5
p-value	<.0001	<.0001	<.0001	<.0001	.0012	.1057
RMSEA	.060	.063	.065	.057	.053	.034
CFI	.926	.934	.937	.959	.973	.992
TLI	.905	.912	.912	.938	.955	.984

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 5

*Item Characteristic Curves for SIP and SIP-CP Ambulation Subscale*

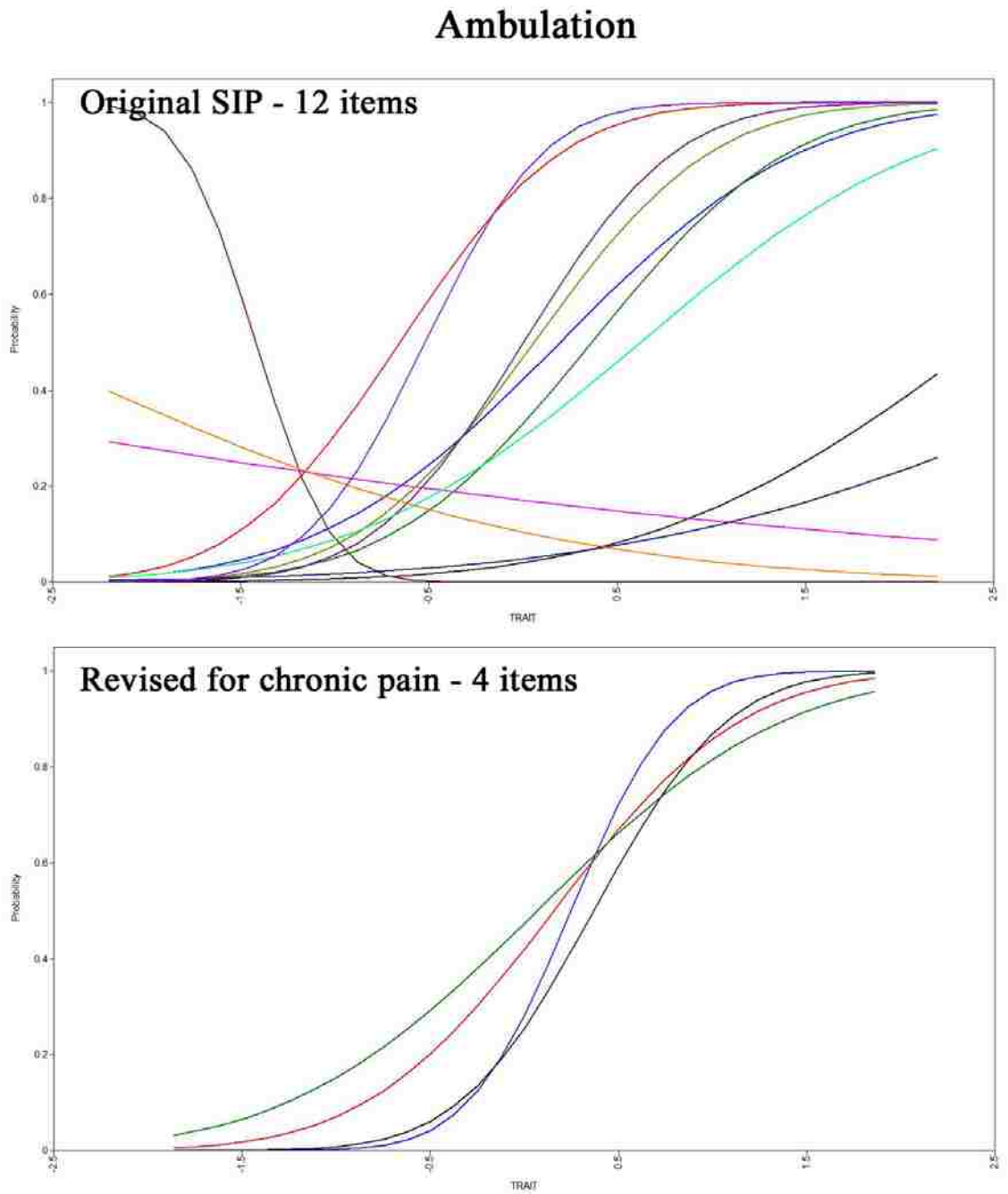


Table 5

*Selection Process for Ambulation Subscale*

Iteration	Original	1	2	3	4	5	6	7	8	9	10	Final
Item number & adjustment (+/-)	N/A	-6	-5	-10	-4	-8	-1	+1, -7	-1	-12	+7	-9
X <sup>2</sup>	838.16	663.11	328.46	157.91	126.57	107.55	86.32	90.80	62.80	13.88	37.15	3.402
df	54	44	35	27	20	14	9	9	5	2	5	2
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	.001	<.0001	.1825
RMSEA	.142	.140	.108	.082	.086	.096	.109	.112	.127	.091	.094	.031
CFI	.648	.685	.839	.926	.936	.941	.936	.928	.931	.977	.955	.997
TLI	.570	.607	.793	.901	.911	.912	.893	.882	.862	.930	.911	.991

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Table 6

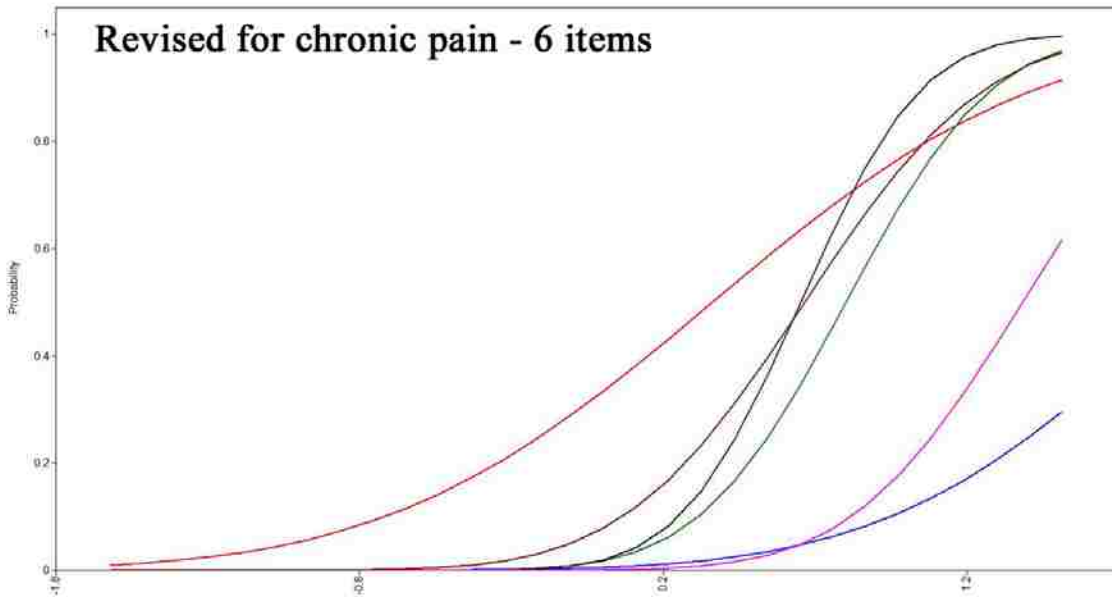
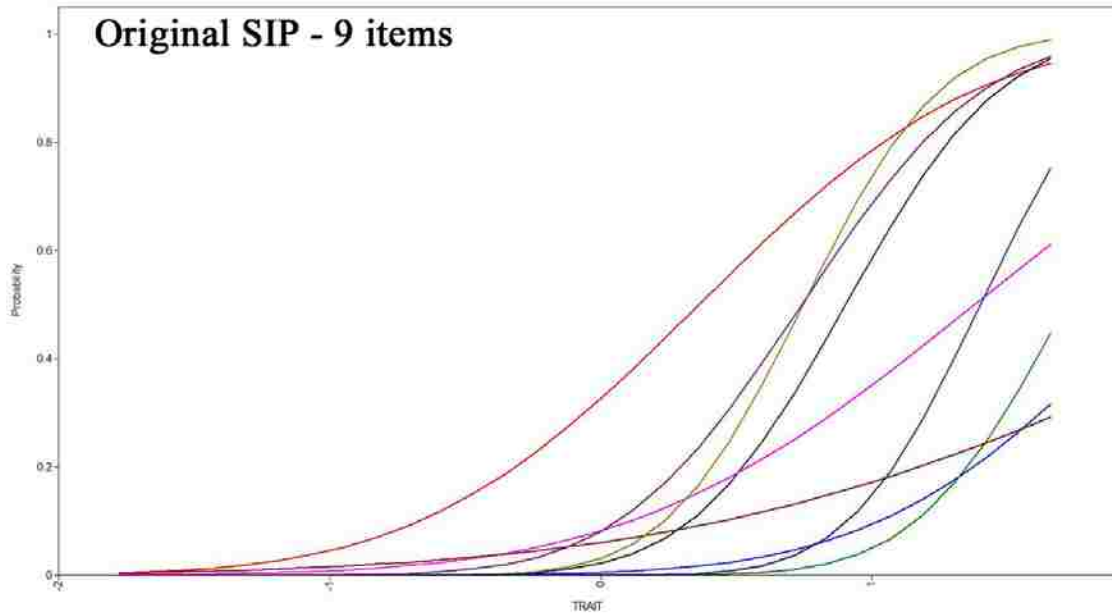
*Model Fit for Subscales Forming the Physical Dimension Score*

	Original SIP Subscale	SIP-CP Subscale
Body Care & Movement	23 items	7 items
$\chi^2$	731.946	36.652
	df=230, p<.001	df=14, p<.001
RMSEA	.055	.047
CFI	.890	.991
TLI	.879	.986
Mobility	10 items	5 items
$\chi^2$	127.107	9.085
	df=35, p<.001	df=5, p=.106
RMSEA	.060	.034
CFI	.926	.992
TLI	.905	.984
Ambulation	12 items	4 items
$\chi^2$	838.158	3.402
	df=54, p<.001	df=2, p=.1825
RMSEA	.142	.031
CFI	.648	.997
TLI	.570	.991

Figure 6

*Item Characteristic Curves for SIP and SIP-CP Communication Subscale*

### Communication



\*Note changes in scale

Table 7

*Selection Process for Communication Subscale*

Iteration	Original	1	2	Final
Item number & adjustment (+/-)	N/A	-6	-3	-5
X <sup>2</sup>	64.931	51.404	46.389	17.139
df	27	20	14	9
p-value	.0001	.0001	<.0001	.0466
RMSEA	.044	.047	.057	.035
CFI	.951	.959	.957	.988
TLI	.935	.943	.935	.980

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 7

*Item Characteristic Curves for SIP and SIP-CP Alertness Behavior Subscale*

### Alertness Behavior

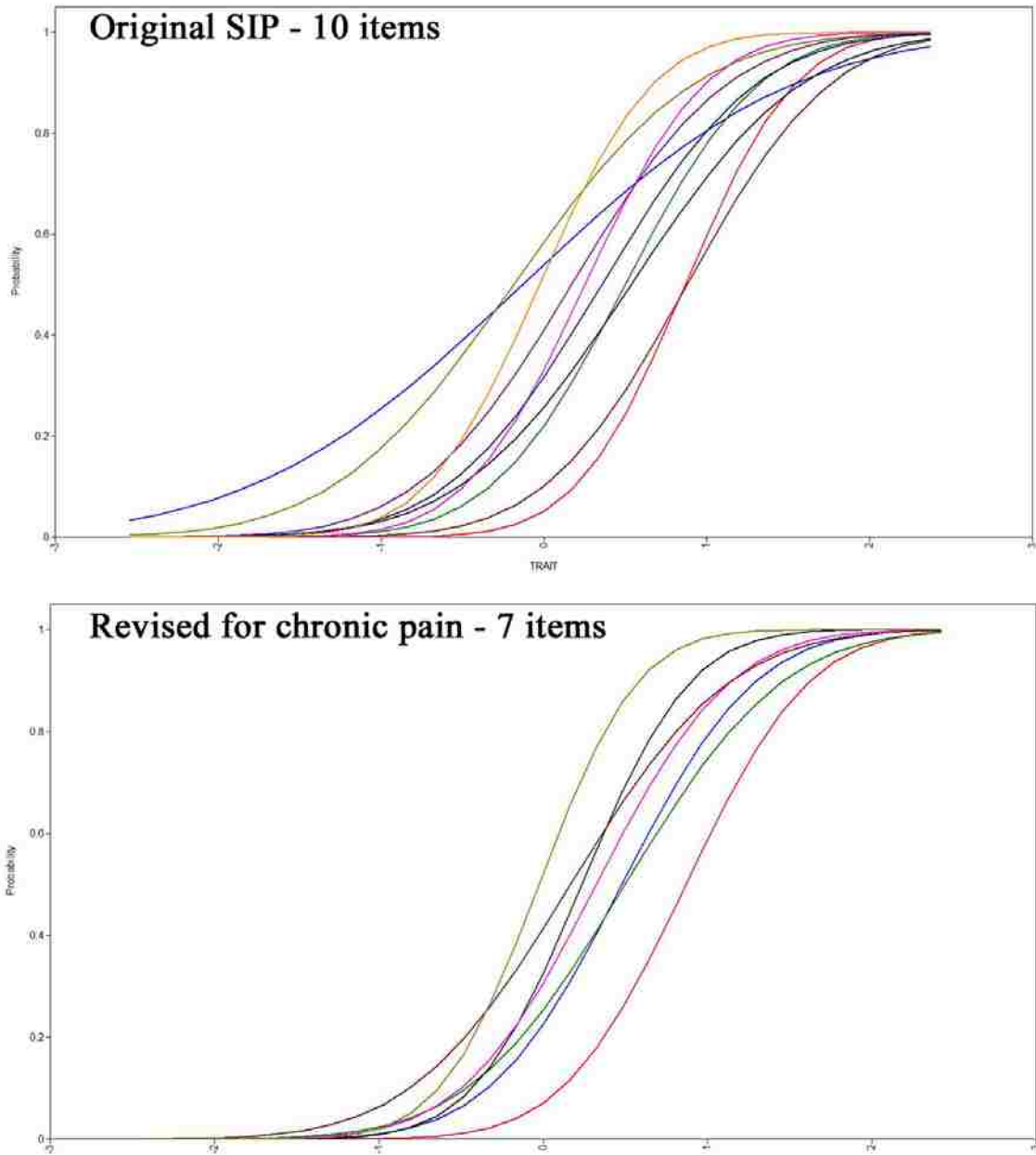


Table 8

*Selection Process for Alertness Behavior Subscale*

Iteration	Original	1	2	Final
Item number & adjustment (+/-)	N/A	-2	-7	-6
X <sup>2</sup>	80.075	55.384	46.167	25.038
df	35	27	20	14
p-value	<.0001	.001	.008	.0342
RMSEA	.065	.054	.060	.047
CFI	.975	.985	.985	.992
TLI	.968	.980	.978	.989

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*



Figure 8

*Item Characteristic Curves for SIP and SIP-CP Emotional Behavior Subscale*

### Emotional Behavior

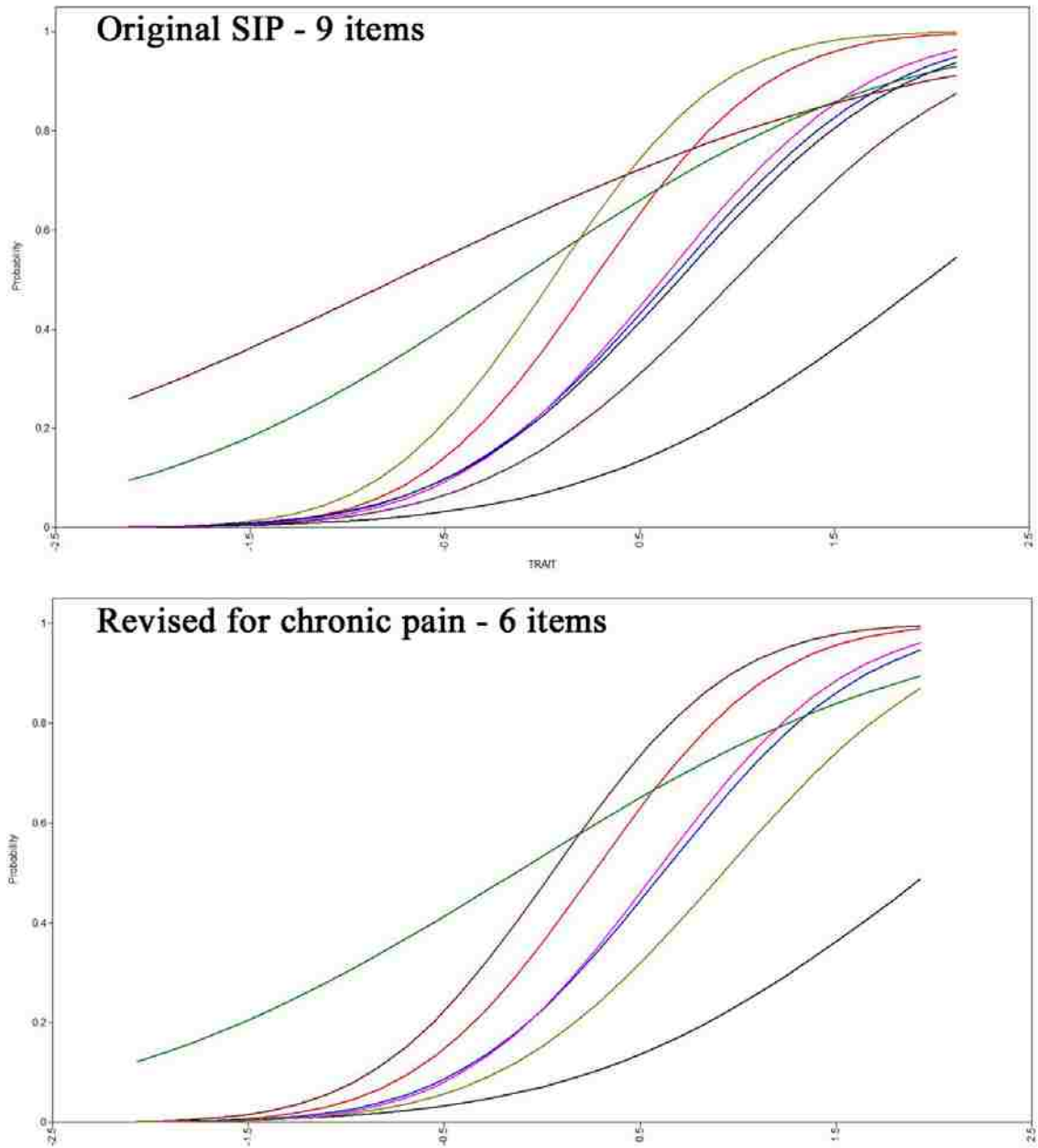


Table 9

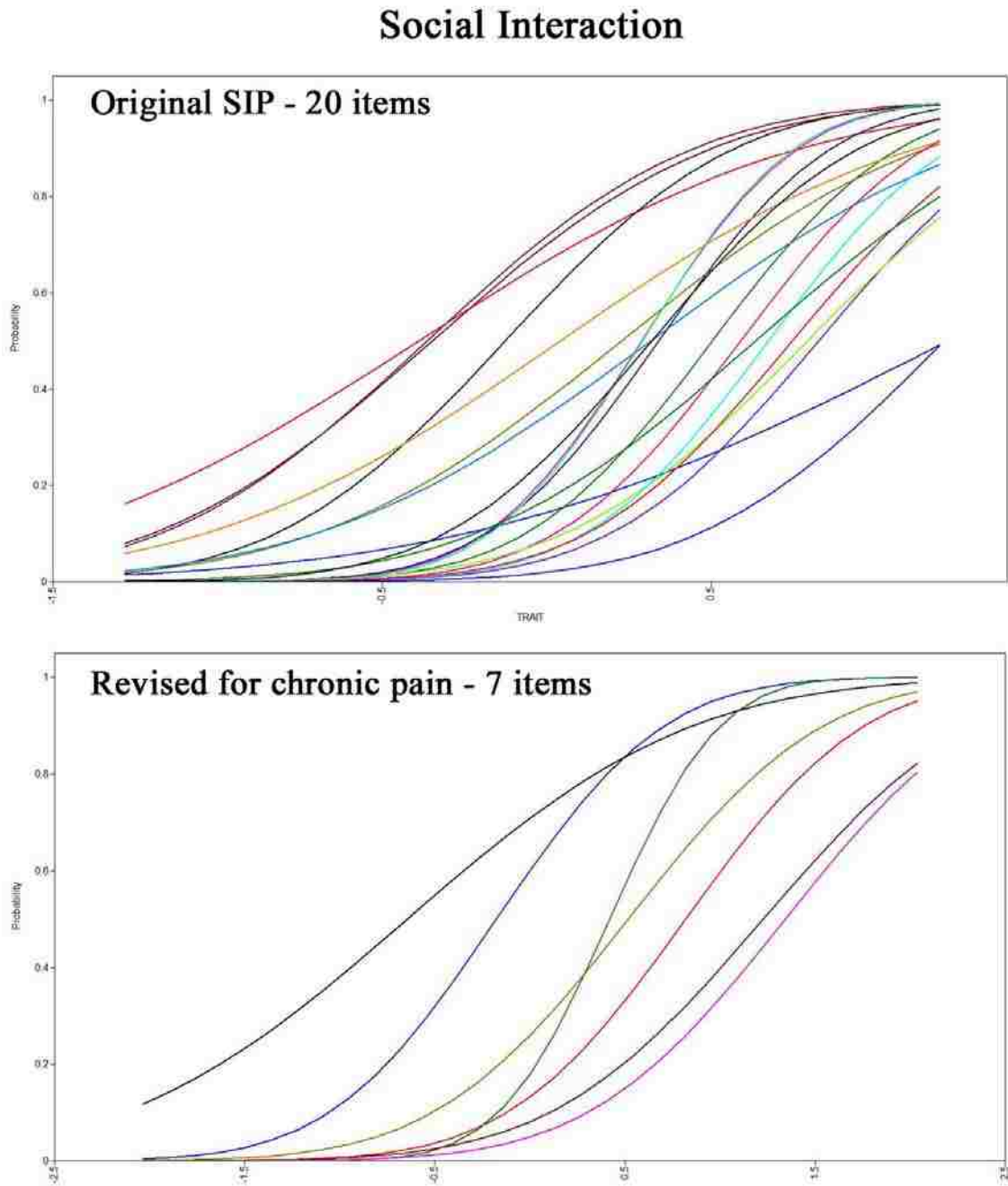
*Selection Process for Emotional Behavior Subscale*

Iteration	Original	1	2	3	4	Final
Item number & adjustment (+/-)	N/A	-6	-3	-8	+3, +8 -2	+2, -8
X <sup>2</sup>	113.591	48.069	39.869	25.811	40.366	33.259
df	27	20	14	9	14	14
p-value	<.0001	.0004	.0003	.0022	.0002	.0026
RMSEA	.067	.044	.051	.051	.051	.044
CFI	.914	.969	.969	.973	.962	.972
TLI	.885	.957	.953	.955	.943	.959

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 9

*Item Characteristic Curves for SIP and SIP-CP Social Interaction Subscale*



\*Note changes in scale

Table 10

*Selection Process for Social Interaction Subscale*

Iteration	Original	1	2	3	4	5	6	7
Item number & adjustment (+/-)	N/A	-2	-13	-11	-10	-1	-7	-6
X <sup>2</sup>	748.09	631.60	568.40	527.25	491.34	362.78	231.23	201.88
df	170	152	135	119	104	90	77	65
p-value	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
RMSEA	.069	.066	.067	.069	.072	.065	.053	.054
CFI	.862	.883	.888	.875	.874	.904	.941	.945
TLI	.846	.868	.873	.857	.854	.888	.931	.934
Iteration	8	9	10	11	12	13	14	Final
Item number & adjustment (+/-)	-19	-8	-16	-18	-14	-15	-9	+15, +9, -17
X <sup>2</sup>	156.97	118.24	82.56	69.64	34.38	9.87	6.24	30.72
df	54	44	35	27	20	14	9	14
p-value	<.0001	<.0001	<.0001	<.0001	.0237	.7714	.7154	.0061
RMSEA	.051	.048	.043	.047	.032	<.0001	<.0001	.041
CFI	.956	.963	.972	.974	.988	1	1	.983
TLI	.946	.953	.964	.966	.983	1.006	1.005	.974

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Table 11

*Model Fit for Subscales Forming the Psychosocial Dimension Score*

	Original SIP Subscale	SIP-CP Subscale
Communication	9 items	6 items
$X^2$	64.931	17.139
	df=27, p<.001	df=9, p<.05
RMSEA	.044	.035
CFI	.951	.988
TLI	.935	.980
Alertness Behavior	10 items	7 items
$X^2$	130.638	25.038
	df=35, p<.001	df=14, p<.05
RMSEA	.062	.047
CFI	.978	.992
TLI	.972	.989
Emotional Behavior	9 items	6 items
$X^2$	113.591	33.259
	df=27, p<.001	df=14, p<.05
RMSEA	.067	.044
CFI	.914	.972
TLI	.885	.959
Social Interaction	20 items	7 items
$X^2$	748.088	30.716
	df=170, p<.001	df=14, p<.05
RMSEA	.069	.041
CFI	.862	.983
TLI	.846	.974

Figure 10

*Item Characteristic Curves for SIP and SIP-CP Sleep & Rest Subscale*

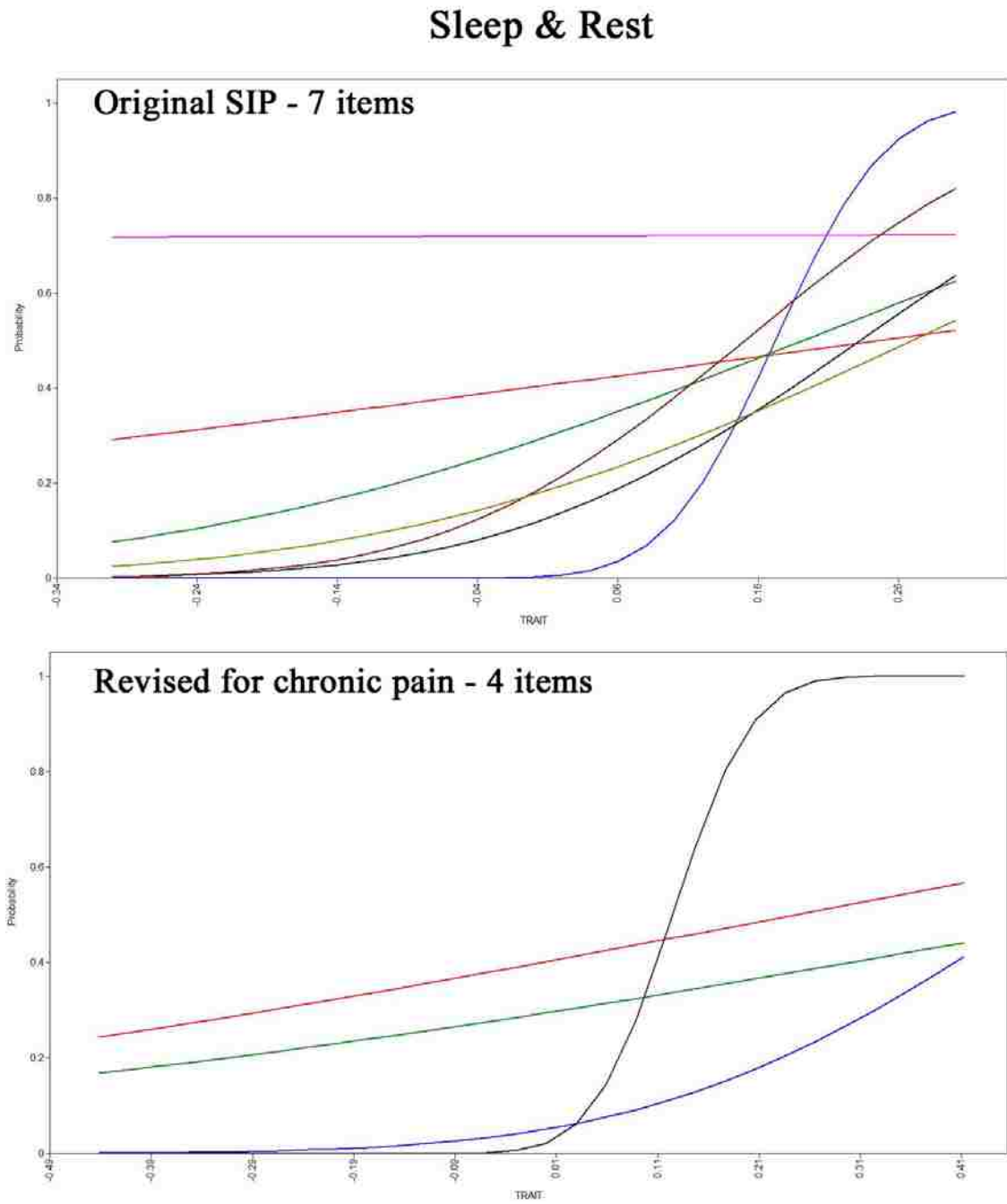


Table 12

*Selection Process for Sleep & Rest Subscale*

Iteration	Original	1	2	Final
Item number & adjustment (+/-)	N/A	-1	-6	-5
X <sup>2</sup>	104.115	12.647	11.369	2.368
df	14	9	5	2
p-value	<.0001	.1792	.0445	.3061
RMSEA	.094	.024	.042	.016
CFI	.430	.957	.925	.988
TLI	.145	.928	.851	.964

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 11

*Item Characteristic Curves for SIP Home Management Subscale*

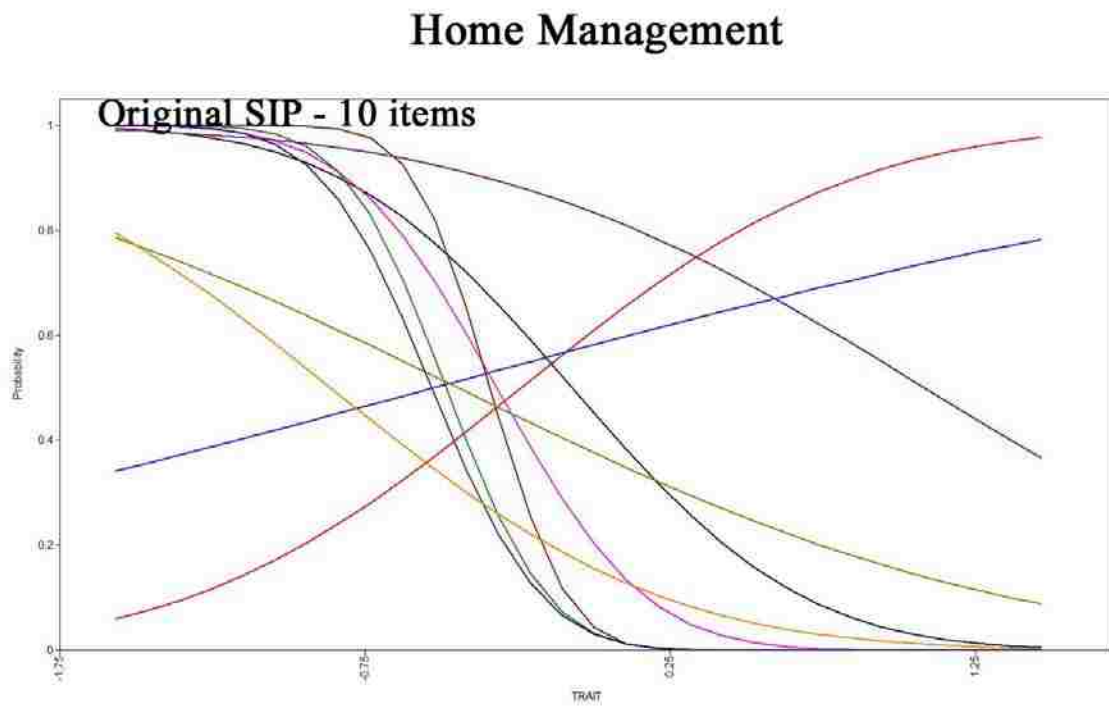




Figure 12

*Item Characteristic Curves for SIP Work Subscale*

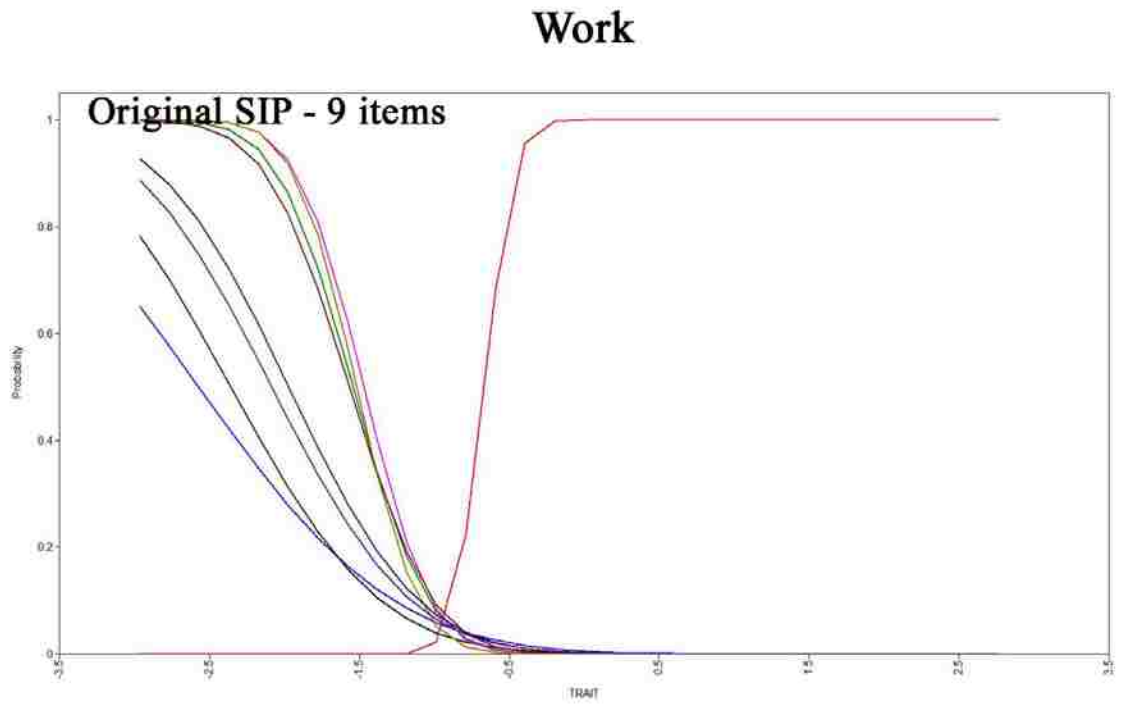


Figure 13

*Item Characteristic Curves for SIP and SIP-CP Recreation & Pastimes Subscale*

### Recreation & Pastimes

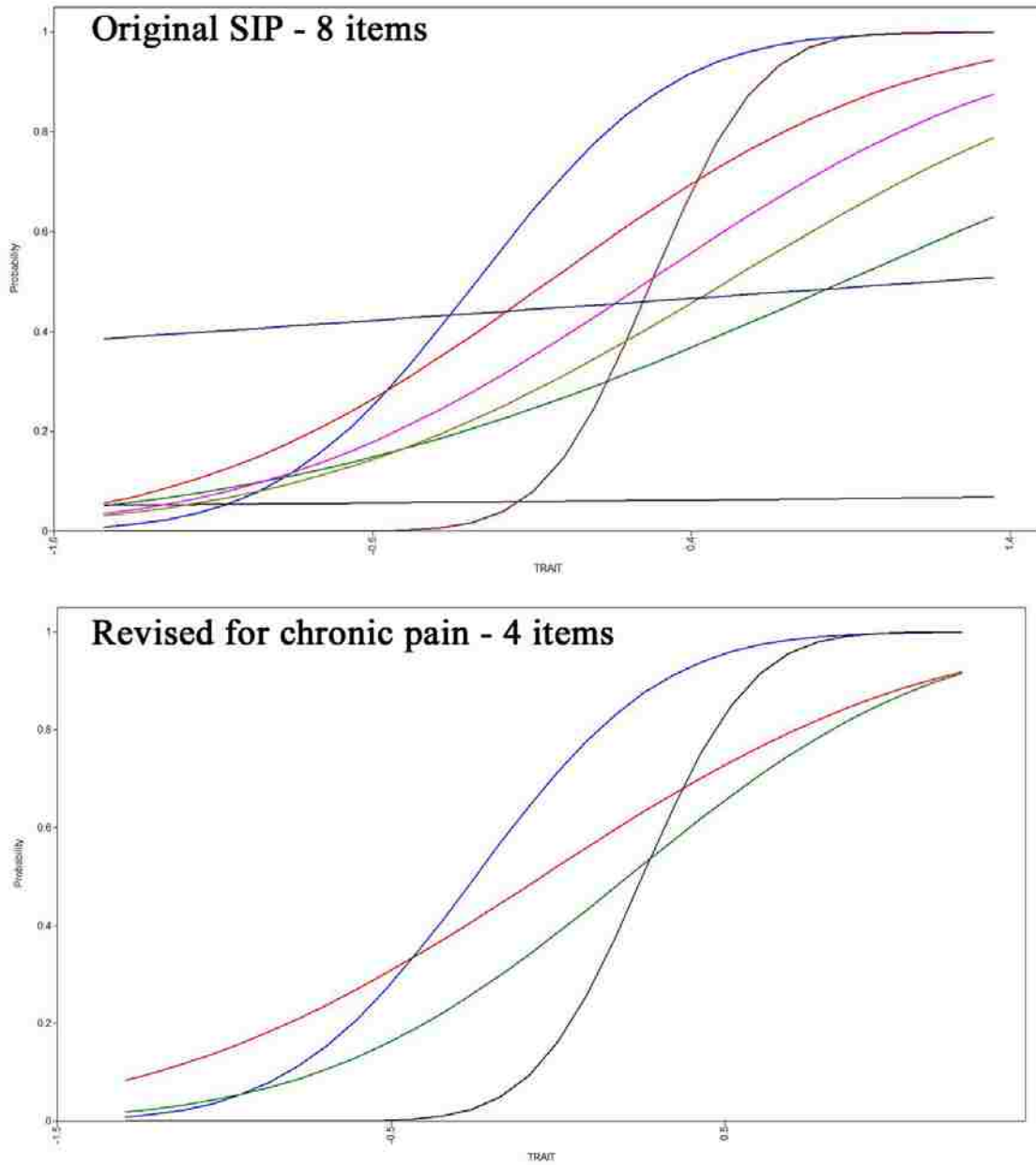


Table 13

*Selection Process for Recreation & Pastimes Subscale*

Iteration	Original	1	2	3	Final
Item number & adjustment (+/-)	N/A	-4	-8	-3	-7
X <sup>2</sup>	279.454	252.094	52.936	12.772	4.792
df	20	14	9	5	2
p-value	<.0001	<.0001	<.0001	.0256	.0911
RMSEA	.134	.153	.082	.046	.044
CFI	.549	.591	.905	.981	.991
TLI	.368	.386	.841	.961	.974

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Figure 14

*Item Characteristic Curves for SIP and SIP-CP Eating Subscale*

## Eating

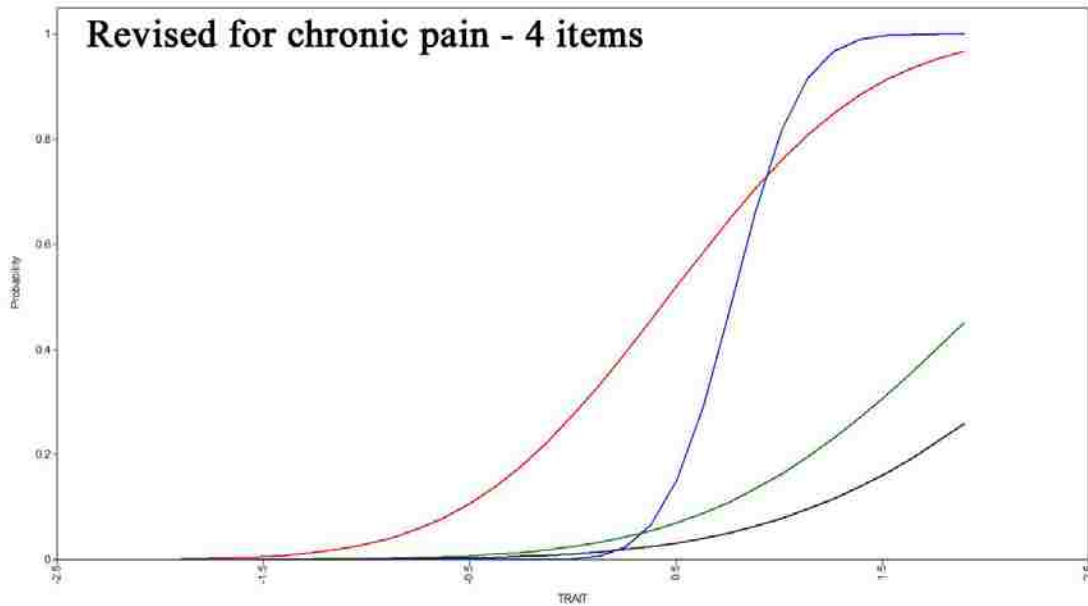
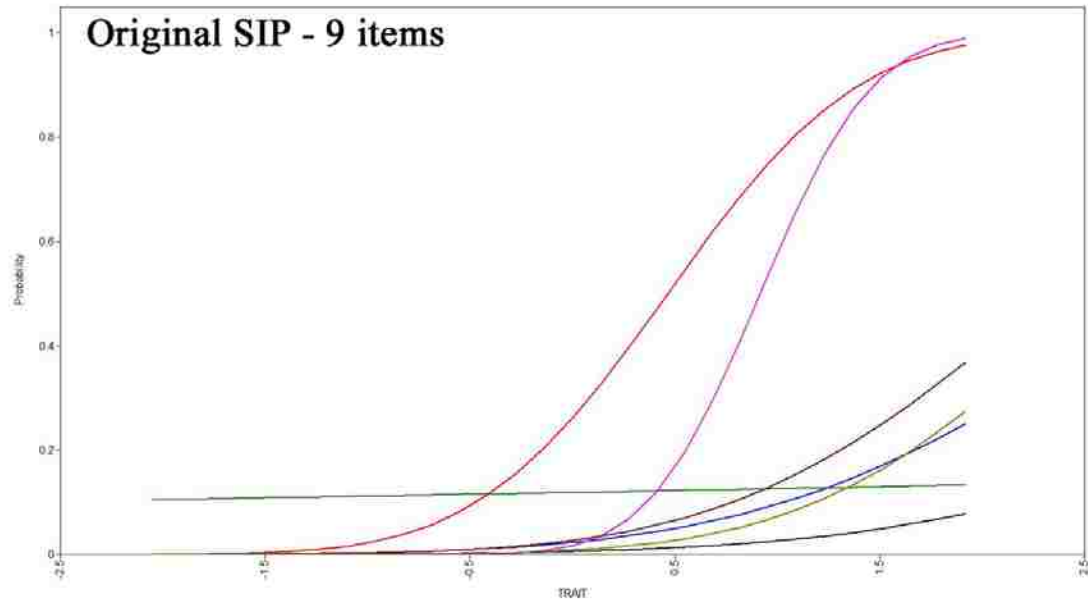


Table 14

*Selection Process for Eating Subscale*

Iteration	Original	1	2	3	Final
Item number & adjustment (+/-)	N/A	-3	-4	-7	+7, -2
X <sup>2</sup>	21.495	13.773	7.133	0.872	2.588
df	14	9	5	2	2
p-value	.0896	.1306	.2109	.6468	.2742
RMSEA	.027	.027	.024	<.0001	.020
CFI	.948	.967	.984	1	.996
TLI	.922	.945	.969	1.025	.988

*Note: RMSEA <.05, CFI >.95, TLI >.95 constitute good fit*

Table 15

*Model Fit for Subscales Forming the Independence/Other Dimension Score*

	Original SIP Subscale	SIP-CP Subscale
Sleep & Rest	7 items	4 items
X <sup>2</sup>	104.115, df=14, p<.001	2.368, df=2, p=.306
RMSEA	.094	.016
CFI	.430	.988
TLI	.145	.964
Home Management	10 items	Excluded, see text
X <sup>2</sup>	412.801, df=35, p<.001	--
RMSEA	.122	--
CFI	.886	--
TLI	.853	--
Work	9 items	Excluded, see text
X <sup>2</sup>	36.020, df=27, p=.1149	--
RMSEA	.022	--
CFI	.999	--
TLI	.998	--
Recreation & Pastimes	8 items	4 items
X <sup>2</sup>	279.454, df=20, p<.001	4.792, df=2, p=.091
RMSEA	.134	.044
CFI	.549	.991
TLI	.368	.974
Eating	9 items	4 items
X <sup>2</sup>	21.495, df=14, p=.0896	2.588, df=2, p=.2742
RMSEA	.027	.020
CFI	.948	.996
TLI	.922	.988

Table 16

*Resulting Model Fit for Total and Dimension Scores*

	Original SIP Subscale	SIP-CP Subscale
Total	136 items	54 items
X <sup>2</sup>	15509.41, df=8777, p<.0001	3481.84, df=1377, p<.0001
RMSEA	.033	.046
CFI	.697	.790
TLI	.692	.782
Physical Dimension	45 items	16 items
X <sup>2</sup>	3109.62, df=945, p<.0001	448.81, df=104, p<.0001
RMSEA	.056	.068
CFI	.778	.918
TLI	.767	.905
Psychosocial Dimension	48 items	26 items
X <sup>2</sup>	2484.19, df=1080, p<.0001	1002.50, df=299, p<.0001
RMSEA	.042	.057
CFI	.877	.894
TLI	.871	.885
Independence/Other	43 items	12 items
X <sup>2</sup>	3714.93, df=779, p<.0001	241.09, df=54, p<.0001
RMSEA	.072	.069
CFI	.575	.628
TLI	.553	.545

Table 17

*Correlations among SIP, SIP68, and SIP-CP Total and Dimension Scores*

Overall Scores			
	SIP	SIP-CP	SIP68
	Total	Total	Total
SIP Total Score	-		
SIP-CP Total Score	.954*	-	
SIP68 Total Score	.964*	.941*	-
Physical Dimension Scores			
	SIP	SIP-CP	SIP68
	Physical	Physical	Physical
SIP Physical	-		
SIP-CP Physical	.923*	-	
SIP68 Physical	.955*	.905*	-
Psychosocial Dimension Scores			
	SIP	SIP-CP	SIP68
	Psychosocial	Psychosocial	Psychosocial
SIP Psychosocial	-		
SIP-CP Psychosocial	.960*	-	
SIP68 Psychosocial	.900*	.895*	-
Independence/Other Dimension Scores			
	SIP	SIP-CP	
	Independence	Independence	
SIP Independence	-		
SIP-CP Independence	.621*	-	

\*p&lt;.001

*Note: SIP-CP correlations here for 54-item version with Independence/Other dimension*



Table 18

*SIP, SIP68, and SIP-CP Correlations with Clinical Measures*

	Total Score				Physical Dimension			Psychosocial Dimension			Independence/Other	
	SIP	SIP-CP <sup>a</sup>	SIP-CP <sup>b</sup>	SIP68	SIP	SIP-CP	SIP68	SIP	SIP-CP	SIP68	SIP	SIP-CP
Depression												
BCMDI (n=358)	.702*	.697*	.686*	.642*	.523*	.469*	.526*	.730*	.691*	.615*	.541*	.321*
BDI-II (n=355)	.603*	.579*	.572*	.550*	.396*	.347*	.416*	.665*	.598*	.567*	.453*	.287*
Pain-related anxiety	.561*	.553*	.541*	.520*	.436*	.396*	.452*	.549*	.527*	.467*	.451*	.244*
Pain-related acceptance	-.503*	-.459*	-.467*	-.441*	-.346*	-.338*	-.382*	-.482*	-.434*	-.397*	-.498*	-.277*
Classes of pain medication	.273*	.251*	.249*	.242*	.286*	.285*	.264*	.190*	.173*	.160*	.250*	.128*
Pain-related medical visits	.319*	.296*	.298*	.287*	.279*	.255*	.279*	.275*	.255*	.226*	.277*	.168*
*p<.001	<sup>a</sup> 42-item, 2 Dimension SIP-CP				<sup>b</sup> 54-item, 3 Dimension SIP-CP (+ Independence/Other)							

Table 19

*Linear Regressions*

	Overall Score			2 Dimensions <sup>a</sup>			3 Dimensions <sup>b</sup>	
	SIP	SIP-CP <sup>b</sup>	SIP68	SIP	SIP-CP	SIP68	SIP	SIP-CP
Depression - BCMDI (n=358)								
R <sup>2</sup>	.500*	.477*	.428*	.548*	.505*	.439*	.549*	.506*
F	69.00	53.32	51.95	69.98	59.06	45.09	69.88	59.14
Depression – BDI-II (n=355)								
R <sup>2</sup>	.403*	.366*	.353*	.465*	.396*	.378*	.472*	.396*
F	47.15	40.21	38.10	60.72	37.95	35.32	51.81	37.95
Pain-related anxiety (PASS-20)								
R <sup>2</sup>	.319*	.296*	.278*	.326*	.311*	.278*	.331*	.311*
F	63.48	57.17	52.33	54.64	51.04	43.67	47.74	50.99
Pain-related acceptance (CPAQ)								
R <sup>2</sup>	.283*	.247*	.235*	.266*	.240*	.235*	.313*	.311*
F	51.68	43.20	40.44	39.69	34.56	33.66	47.74	50.99
Classes of pain medication								
R <sup>2</sup>	.078*	.065*	.061*	.085*	.083*	.072*	.084*	.082*
F	11.82	9.84	9.16	13.07	12.72	10.92	12.87	12.63
Pain-related medical visits								
R <sup>2</sup>	.116*	.104*	.100*	.112*	.104*	.103*	.112*	.104*
F	17.96	15.87	15.20	14.38	13.29	13.09	14.33	13.29

\*p&lt;.001

<sup>a</sup>42-item, 2 Dimension SIP-CP<sup>b</sup>54-item SIP-CP with 3 Dimensions (+ Independence/Other)

Table 20

*Internal Consistency (Cronbach's alpha) of SIP and SIP-CP Scales*

	SIP	SIP-CP
<b>Total disability score</b>	<b>.936</b>	<b>.883</b>
<b>Physical dimension</b>	<b>.884</b>	<b>.810</b>
Ambulation	.673	.620
Mobility	.696	.597
Body care & movement	.813	.775
<b>Psychosocial dimension</b>	<b>.900</b>	<b>.858</b>
Communication	.630	.616
Alertness behavior	.843	.825
Emotional behavior	.669	.637
Social interaction	.815	.677
<b>Independence/Other dimension</b>	<b>.705</b>	<b>.475</b>
Sleep & rest	.251	.145
Eating	.355	.429
Work	.515	---
Home management	.620	---
Recreation & pastimes	.484	.543

*Note: Cronbach alpha coefficients >.7 indicate acceptable internal reliability*

Table 21

*Confirmatory Factor Analysis of SIP-CP Scales*

	54-items / 10 Subscales / 3 Dimensions	42-items / 7 Subscales / 2 Dimensions
<b>Item to dimension</b>		
X <sup>2</sup>	2549.387, df=1374, p<.001	1823.496, df=818, p<.001
RMSEA	.034	.041
CFI	.883	.897
TLI	.878	.891
<b>Item to total score</b>		
X <sup>2</sup>	N/A	2883.330, df=819, p<.001
RMSEA	N/A	.059
CFI	N/A	.788
TLI	N/A	.777
<b>Subscale to dimension</b>		
X <sup>2</sup>	N/A	81.560, df=13, p<.001
RMSEA	N/A	.121
CFI	N/A	.851
TLI	N/A	.759

## APPENDICES

### Appendix A: Sickness Impact Profile

#### SIP

PLEASE RESPOND TO (TICK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

#### SR

1.  I spend much of the day lying down in order to rest.
2.  I sit during much of the day.
3.  I am sleeping or dozing most of the time - day and night.
4.  I lie down more often during the day in order to rest.
5.  I sit around half-asleep.
6.  I sleep less at night, for example, wake up too early, don't fall asleep for a long time, and awaken frequently.
7.  I sleep or nap more during the day.

#### EB

1.  I say how bad or useless I am, for example, that I am a burden to others.
2.  I laugh or cry suddenly.
3.  I often moan and groan in pain or discomfort.
4.  I have attempted suicide.
5.  I act nervous or restless.
6.  I keep rubbing or holding areas of my body that hurt or are uncomfortable.
7.  I act irritable and impatient with myself; for example, I talk badly about myself, swear at myself, and blame myself for things that happen.
8.  I talk about the future in a hopeless way.
9.  I get sudden frights.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

**BCM**

1.  I make difficult moves with help, for example, getting into or out of cars, the bath.
2.  I do not move in or out of a bed or chair by myself but am moved by another person or mechanical aid.
3.  I stand only for short periods of time.
4.  I do not maintain my balance.
5.  I move my hands or fingers with some limitation or difficulty.
6.  I stand up only with someone's help.
7.  I kneel, stoop, or bend down only by holding on to something.
8.  I am in a restricted position all of the time.
9.  I am very clumsy in body movements.
10.  I get in or out of bed or chairs by grasping something for support or by using a cane or walker.
11.  I stay lying down most of the time.
12.  I change positions frequently.
13.  I hold on to something to move myself around in bed.
14.  I do not bathe myself completely, for example, I require assistance with bathing.
15.  I do not bathe myself, but am bathed by someone else.
16.  I use a bedpan with assistance.
17.  I have trouble getting shoes, socks, stocking on.
18.  I do not have control of my bladder.
19.  I do not fasten my clothing, for example, I require assistance with buttons, zippers, and shoelaces.
20.  I spend most of my time partly undressed or in pajamas.
21.  I do not have control of my bowels.
22.  I dress myself, but do so very slowly.
23.  I get dressed only with someone's help.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

This group of statements is to do with anything you usually do in caring for your home or garden. Considering just those things that you do, please respond by ticking only those statements that you are sure describe you today and are related to your state of health.

### HM

1.  I do work around the house only for short periods of time and rest often.
2.  I am doing less of the regular daily work around the house than I would usually do.
3.  I am not doing any of the regular daily work around the house than I would usually do.
4.  I am not doing any of the maintenance or repair work that I would usually do in my home or garden.
5.  I am not doing any of the shopping that I would usually do.
6.  I am not doing any of the house cleaning that I would usually do.
7.  I have difficulty doing handwork, for example, turning taps, using kitchen gadgets, sewing, carpentry.
8.  I am not doing any of the clothes washing that I would usually do.
9.  I am not doing heavy work around the house.
10.  I have given up taking care of personal or household business affairs, for example, paying bills, banking, working on a budget.

### M

1.  I am getting around only within one building.
2.  I stay within one room.
3.  I am staying in bed more.
4.  I am staying in bed most of the time.
5.  I am not now using public transport.
6.  I stay at home most of the time.
7.  I am only going to places with toilets nearby.
8.  I am not going in to town.
9.  I stay away from home only for brief periods of time.
10.  I do not get around in the dark or in unlit places without someone else to help me.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

**SI**

1.  I am going out less to visit people
2.  I am not going out to visit people at all.
3.  I show less interest in other people's problems, for example, I don't listen when they tell me about their problems, I don't offer to help.
4.  I often act irritable to those around me, for example, snap at people, give sharp answers, criticize easily.
5.  I show less affection.
6.  I am doing fewer social activities with groups of people.
7.  I am cutting down on the length of visits with friends.
8.  I am avoiding social visits from others.
9.  My sexual activity is decreased.
10.  I often express concern over what might be happening to my health.
11.  I talk less with those around me.
12.  I make many demands, for example, insist that people do things for me, tell them how to do things.
13.  I stay alone much of the time.
14.  I act disagreeable to family members, for example, I act spiteful, I am stubborn.
15.  I have frequent outbursts of anger at family members, for example, strike at them, scream, or throw things at them.
16.  I isolate myself as much as I can from the rest of the family.
17.  I am paying less attention to the children.
18.  I refuse contact with family members, for example, turn them away.
19.  I am not doing the things that I usually do to take care of my children or family.
20.  I am not joking with my family members as I usually do.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**



**A**

1.  I walk shorter distances or stop often to rest.
2.  I do not walk up or down hills.
3.  I use stairs only with mechanical support, for example, handrails, stick, crutches.
4.  I walk up or down stairs only with support from someone else.
5.  I get around in a wheelchair.
6.  I do not walk at all.
7.  I walk by myself, but with some difficulty, for example, limp, wobble, stumble, have stiff legs.
8.  I walk only with help from someone.
9.  I go up and down stairs more slowly, for example, one step at a time, stop often.
10.  I do not use stairs at all.
11.  I get around only by using a walker, crutches, stick, walls, or furniture.
12.  I walk more slowly.

**AB**

1.  I am confused and start several actions at a time.
2.  I have more minor accidents, for example, drop things, trip and fall, bump into things.
3.  I react slowly to things that are said or done.
4.  I do not finish things that I start.
5.  I have difficulty reasoning and solving problems, for example, making plans, making decisions, learning new things.
6.  I sometimes behave as if I were confused or disorientated in place or time, for example, where I am, who is around, directions, what day it is.
7.  I forget a lot, for example, things that have happened recently, where I have put things, appointments.
8.  I do not keep my attention on activities for long.
9.  I make more mistakes than usual.
10.  I have difficulty doing activities that involve concentration and thinking.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

**C**

1.  I am having trouble writing or typing.
2.  I communicate mostly by gestures, for example, moving head, pointing, sign language.
3.  My speech is understood by only a few people who know me well.
4.  I often lose control of my voice when I talk; for example, my voice gets louder, or softer, trembles, changes unexpectedly
5.  I don't write except to sign my name.
6.  I carry on a conversation only when very close to the other person or looking at them.
7.  I have difficulty speaking, for example, get stuck, stutter, stammer, slur my words.
8.  I am understood with difficulty.
9.  I do not speak clearly when I am under stress.

**The next group of statements are to do with any work that you usually do other than managing your home. By this, we mean anything that you regard as work that you do on a regular basis.**

**Do you usually work other than managing your home?**       YES       NO

**IF YOU ANSWERED YES:**  
**GO TO THE NEXT PAGE**

**IF YOU ANSWERED NO:**  
**THEN PLEASE CONTINUE**

**Are you retired?**       YES       NO

**If you retired, was this due to your health?**       YES       NO

**If you are not retired, but are not working, is this related to your health?**       YES       NO

**SKIP THE NEXT**  
**PAGE**

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

**IF YOU ARE NOT WORKING AND IT IS NOT BECAUSE OF YOUR HEALTH,**

**PLEASE SKIP THIS PAGE**

Now please consider the work that you do and tick **only** those statements that you are **sure** describe you today and are related to your state of health. (If today is a weekend or some other day that you would usually have off, please respond as if today were a working day).

w

1.  I am not working at all. (If you ticked this item then please go to next page)
2.  I am doing part of my job at home.
3.  I am not accomplishing as much as usual at work.
4.  I often act irritable toward my work associates, for example, snap at them, give sharp answers, criticize easily.
5.  I am working shorter hours.
6.  I am doing only light work.
7.  I work only for short periods of time or take frequent rests.
8.  I am working at my usual job but with some changes, for example, using different tools or special aids, trading some tasks with other workers.
9.  I do not do my job as carefully and accurately as I usually do.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

This group of statements is to do with activities that you usually do in your free time.

These activities are things that you might do for relaxation, to pass the time, or for entertainment. Please tick only those statements that you are sure describe you today and are related to your state of health.

**RP**

1.  I do my hobbies and recreation activities for shorter periods of time.
2.  I am going out for entertainment less often.
3.  I am cutting down on some of my usual inactive recreation and pastimes, for example, watching TV, playing cards, reading.
4.  I am not doing any of my usual inactive recreation and pastimes, for example, watching TV, playing cards, reading.
5.  I am doing more inactive pastimes in place of my usual activities.
6.  I am doing fewer community activities.
7.  I am cutting down on some of my usual physical recreation or activities.
8.  I am not doing any of my usual physical recreation or activities.

**E**

1.  I am eating much less than usual.
2.  I feed myself but only by using specially prepared food or utensils.
3.  I am eating special or different food, for example, soft food, bland diet, low-salt, low-fat, low-sugar.
4.  I eat no food at all but I am drinking fluids.
5.  I just pick or nibble at my food.
6.  I am drinking less fluids.
7.  I feed myself with help from someone else.
8.  I do not feed myself at all, but must be fed.
9.  I am eating no food at all; nutrition is taken through tubes or intravenous fluids.

**Now can you please review the questions to be certain that you have filled out all the information?**

Look at the last tick box on each sheet to make sure that you have not missed a page.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

## Appendix B: Sickness Impact Profile 68 (SIP68)

### SIP68

PLEASE RESPOND TO (TICK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

#### Somatic Autonomy

1.  I get around in a wheelchair.
2.  I get dressed only with someone's help.
3.  I do not move into or out of bed by myself, but am moved by a person or mechanical aid.
4.  I stand up only with someone's help.
5.  I do not fasten my clothing, for example, require assistance with buttons, zippers, shoelaces.
6.  I do not walk at all.
7.  I do not use stairs at all.
8.  I make difficult moves with help, for example, require assistance with bathing.
9.  I do not bathe myself completely, for example, require assistance with bathing.
10.  I do not bathe myself at all, but am bathed by someone else.
11.  I do not have control of my bladder.
12.  I am very clumsy in body movements.
13.  I do not have control of my bowels.
14.  I feed myself with help from someone else.
15.  I do not maintain balance.
16.  I use a bedpan with assistance.
17.  I am in a restricted position all the time.

### **Mobility Control**

1.  I go up and down stairs more slowly, for example, one step in a time, stop often.
2.  I walk shorter distances or stop to rest often.
3.  I walk more slowly.
4.  I use stairs only with mechanical support, for example, handrail, cane, crutches.
5.  I walk by myself with some difficulty, for example, limp, wobble, stumble, have stiff legs.
6.  I kneel, stoop, or bend down only by holding on to something.
7.  I do not walk up or down hills.
8.  I get in and out of bed or chairs by grasping something for support, or using a cane or walker.
9.  I stand only for short periods of time.
10.  I dress myself, but do so very slowly.
11.  I have difficulty doing handwork, for example, turning faucets, using kitchen gadgets, sewing, carpentry.
12.  I move my hands or fingers with some limitation or difficulty.

### **Psychological Autonomy & Communication**

1.  I have difficulty reasoning and solving problems, for example, making plans, making decisions, learning new things.
2.  I have difficulty doing activities involving concentration and thinking.
3.  I react slowly to things that are said or done.
4.  I make more mistakes than usual.
5.  I do not keep my attention on any activity for long.
6.  I forget a lot, for example, things that happened recently, where I put things, appointments.
7.  I am confused and start several actions at a time.
8.  I do not speak clearly when I am under stress.
9.  I have difficulty speaking, for example, get stuck, stutter, stammer, slur my words.
10.  I do not finish things I start.
11.  I am having trouble writing or typing.

### **Social Behavior**

1.  My sexual activity is decreased.
2.  I am cutting down the length of visits with friends.
3.  I am drinking less fluids.
4.  I am doing fewer community activities.
5.  I am doing fewer social activities with groups of people.
6.  I am going out for entertainment less often.
7.  I stay away from home only for brief periods of time.
8.  I am eating much less than usual.
9.  I am not doing heavy work around the house.
10.  I do my hobbies and recreation for shorter periods of time.
11.  I am doing less of the regular daily work around the house than I would usually do.
12.  I am cutting down on some of my usual inactive recreation and pastime, for example, watching TV, playing cards, reading.

### **Emotional Stability**

1.  I often act irritable toward those around me, for example, snap at people, give sharp answers, criticize easily.
2.  I act disagreeable to family members, for example, I act spiteful, I am stubborn.
3.  I have frequent outbursts of anger at family members, for example, strike at them, scream, throw things at them.
4.  I act irritable and impatient with myself, for example, talk badly about myself, swear at myself, blame myself for things that happen.
5.  I am not joking with family members as I usually do.
6.  I talk less with those around me.

### **Mobility Range**

1.  I am not doing any of the shopping that I would usually do.
2.  I am not going into town.
3.  I am not doing any of the house cleaning that I would usually do.
4.  I am not doing any of the regular work around the house that I would usually do.
5.  I stay home most of the time.
6.  I am not doing any of the clothes washing that I would usually do.
7.  I am not going out to visit people at all.
8.  I am getting around only within one building.
9.  I have given up taking care of personal or household business affairs, for example,  
paying bills, banking, working on a budget.
10.  I do not get around in the dark or in unlit places without someone's help.



## Appendix C: Sickness Impact Profile for Chronic Pain (SIP-CP)

### SIP for Chronic Pain

PLEASE RESPOND TO (TICK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

#### EB

- 1  I say how bad or useless I am, for example, that I am a burden to others.
- 2  I laugh or cry suddenly.
- 3  I often moan and groan in pain or discomfort.
- 5  I act nervous or restless.
- 7  I act irritable and impatient with myself; for example, I talk badly about myself, swear at myself, and blame myself for things that happen.
- 9  I get sudden frights.

#### BCM

- 1  I make difficult moves with help, for example, getting into or out of cars, the bath.
- 2  I do not move in or out of a bed or chair by myself but am moved by another person or mechanical aid.
- 6  I stand up only with someone's help.
- 14  I do not bathe myself completely, for example, I require assistance with bathing
- 17  I have trouble getting shoes, socks, stocking on.
- 19  I do not fasten my clothing, for example, I require assistance with buttons, zippers, and shoelaces.
- 23  I get dressed only with someone's help.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

This group of statements is to do with anything you usually do in caring for your home or garden. Considering just those things that you do, please respond by ticking only those statements that you are sure describe you today and are related to your state of health.

**M**

- 1  I am getting around only within one building.
- 2  I stay within one room.
- 4  I am staying in bed most of the time.
- 6  I stay at home most of the time.
- 8  I am not going in to town.

**SI**

- 3  I show less interest in other people's problems, for example, I don't listen when they tell me about their problems, I don't offer to help.
- 4  I often act irritable to those around me, for example, snap at people, give sharp answers, criticize easily.
- 5  I show less affection.
- 9  My sexual activity is decreased.
- 12  I make many demands, for example, insist that people do things for me, tell them how to do things.
- 15  I have frequent outbursts of anger at family members, for example, strike at them, scream, or throw things at them.
- 20  I am not joking with my family members as I usually do.

**A**

- 2  I do not walk up or down hills.
- 3  I use stairs only with mechanical support, for example, handrails, stick, crutches.
- 7  I walk by myself, but with some difficulty, for example, limp, wobble, stumble, have stiff legs.
- 11  I get around only by using a walker, crutches, stick, walls, or furniture.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

**AB**

- 1  I am confused and start several actions at a time.
- 3  I react slowly to things that are said or done.
- 4  I do not finish things that I start.
- 5  I have difficulty reasoning and solving problems, for example, making plans, making decisions, learning new things.
- 8  I do not keep my attention on activities for long.
- 9  I make more mistakes than usual.
- 10  I have difficulty doing activities that involve concentration and thinking.

**C**

- 1  I am having trouble writing or typing.
- 2  I communicate mostly by gestures, for example, moving head, pointing, sign language.
- 4  I often lose control of my voice when I talk; for example, my voice gets louder, or softer, trembles, changes unexpectedly
- 7  I have difficulty speaking, for example, get stuck, stutter, stammer, slur my words.
- 8  I am understood with difficulty.
- 9  I do not speak clearly when I am under stress.

**Now can you please review the questions to be certain that you have filled out all the information?**

Look at the last tick box on each sheet to make sure that you have not missed a page.

**TICK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE**

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