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An item bank was created to improve the measurement of cancer-related fatigue

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Abstract

Objective: Cancer-related fatigue (CRF) is one of the most common unrelieved symptoms experienced by patients. CRF is underrecognized and undertreated due to a lack of clinically sensitive instruments that integrate easily into clinics. Modern computerized adaptive testing (CAT) can overcome these obstacles by enabling precise assessment of fatigue without requiring the administration of a large number of questions. A working item bank is essential for development of a CAT platform. The present report describes the building of an operational item bank for use in clinical settings with the ultimate goal of improving CRF identification and treatment.

Study Design and Setting: The sample included 301 cancer patients. Psychometric properties of items were examined by using Rasch analysis, an Item Response Theory (IRT) model.

Results and Conclusion: The final bank includes 72 items. These 72 unidimensional items explained 57.5% of the variance, based on factor analysis results. Excellent internal consistency ($\alpha = 0.99$) and acceptable item–total correlation were found (range: 0.51–0.85). The 72 items covered a reasonable range of the fatigue continuum. No significant ceiling effects, floor effects, or gaps were found. A sample short form was created for demonstration purposes. The resulting bank is amenable to the development of a CAT platform.

Keywords: Cancer-related fatigue (CRF); Item bank; Item response theory (IRT); Computerized adaptive testing (CAT); Rasch analysis; Short form

1. Introduction

Cancer-related fatigue (CRF) is defined as an overwhelming and sustained sense of exhaustion that decreases one's capacity for physical and mental work [1]. Although it is one of the most common unrelieved symptoms experienced by patients with cancer [2–6], it is underrecognized and undertreated [7]. Fatigue can result from the disease process itself, disease progression, treatment effects (e.g., chemotherapy, radiation), and/or from medications (e.g., opiods for pain management). The reported prevalence of CRF ranges widely, from 18% to 96% [8,9]. Patients typically find CRF very distressing, because it has profound effects across many areas of life. Fatigue diminishes the ability to work, or work effectively, and to function at one's usual level in family roles. Many patients find themselves unable to participate in social and physical activities. Untreated fatigue also contributes to emotional distress.

Complaints of fatigue are not unique to patients with cancer. Fatigue is a common symptom in many chronic diseases, such as rheumatoid arthritis [10] and multiple sclerosis [11]. Many people in the general population who are without chronic disease also complain of fatigue. Hjermstad et al. [12] estimated that approximately 20% of men and 30% of women in the general population complain of frequent tiredness. Glaus [13] found that 55% of healthy individuals reported a physical sensation of fatigue or tiredness, 21% identified an affective sensation of fatigue, and 24% identified cognitive fatigue. Therefore, one challenge that researchers and clinicians face is to distinguish ordinary time-limited fatigue experienced by many from the pervasive and debilitating fatigue experienced by cancer patients.

Many instruments have been developed to measure self-reported fatigue, such as the Functional Assessment of Chronic Illness Therapy—Fatigue (FACIT-F) [14,15], the

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Brief Fatigue Inventory (BFI) [16], the Piper Fatigue Scale [17], the Multidimensional Fatigue Inventory [18], and the Fatigue Symptom Inventory [19]. These fatigue instruments can be classified as either multidimensional (attempting to capture the clinical multidimensionality of fatigue, such as the Multidimensional Fatigue Inventory) or unidimensional (based upon empirically observed high correlations across fatigue dimensions, such as FACIT-F). Both uni- and multidimensional instruments meet a critical need by obtaining an estimate of CRF severity. With growing interest in testing interventions to treat CRF, there is an increasing need to measure it in clinical setting. This requires accuracy and efficiency. Conventional test approaches require administration of many items (and the same set of items each time) to obtain a score, or estimate of fatigue. This can be time-consuming and energy-depleting for persons with significant fatigue. The computerized adaptive testing (CAT) enables precise assessment of fatigue without requiring the administration of a large number of items, by selecting only those questions from an item bank that provide the maximum amount of information based upon a person's responses to previous questions. Such an approach allows clinically sensitive, rapid, and accurate identification of fatigue in busy oncology practices. Because CAT provides a valid, accurate, and real-time measurement of fatigue, the results can be used to guide treatment decisions and to track patient-reported responsiveness to fatigue intervention. The development of a comprehensive and methodologically sound item bank is a prerequisite to the development of a CAT platform. Building upon our previous work [20–22], in the present study we sought to further develop a comprehensive and psychometrically sound fatigue item bank with the ultimate goal of creating a CAT platform for fatigue. A six-item short form was created for clinical use, following the completion of the development of the operational fatigue item bank.

2. Materials and methods

2.1. Procedures and participants

2.1.1. Development of a preliminary fatigue item bank

The preliminary fatigue item bank consisted of 92 items. Thirteen items came from the FACIT-F. One came from the Functional Assessment of Cancer Therapy–General (FACT-G) questionnaire, which is included in the FACIT measurement system [14]. The remaining 78 fatigue items were written by the study team after review of the literature, to cover gaps and to eliminate ceiling and floor effects in terms of both content and item difficulty. Of the 78 new items, 34 were positively worded, 34 were negatively worded, and 10 addressed activity interference. The positively and negatively worded items were written as pairs, with each version representing the opposite orientation related to the same activity. For example, the positively worded item *"I have had enough energy to climb one flight of stairs"* had a corresponding negatively worded item *"I have been too tired to climb one flight of stairs."* We included these paired items to test whether a positively worded item located at a different fatigue level (i.e., less fatigue, better quality of life) than the corresponding negatively worded item. Because the complete FACT-G and a repeat administration of the FACIT-F scale (using a different rating scale) were also included, the complete testing platform was 131 items in length.

2.1.2. Subjects and procedures

Patients were recruited from five oncology clinics in the Chicago metropolitan area. Patients were eligible for participation if they were 18 years of age or older, able to speak and read English, and carried a diagnosis of cancer. The institutional review board (IRB) at all five clinics had approved the present study before we approached their patients. Of 328 eligible patients approached, 304 (92.7%) agreed to participate. After patients signed the informed consent, they were asked to answer all 131 items using a touch-screen laptop computer. A research assistant was present throughout the administration process to answer any questions.

The average length of time to complete the fatigue computer-based testing (CBT) was 17.9 ± 7.8 minutes (range: 6.2–66.6). The majority of patients (59.8%) completed the testing within 20 minutes. Pilot testing of the CBT with research staff was used to determine the minimal reasonable amount of time required to complete the set of items. The validity of the responses was considered questionable when the completion took less than 5 minutes (an average response time of 2.29 seconds per item). Three subjects were removed from the analysis because their completion time was below this limit.

The final sample used to analyze the fatigue item bank consisted of 301 patients. The majority of patients were female and white. The mean age of the sample was 57.0 ± 14.4 years (range: 23.9–89.1) and the mean self-rated Eastern Cooperative Oncology Group Performance Status Rating (ECOG PSR) score was 1.00 ± 0.84, with 30.2% reporting no symptoms and 45.7% reporting ambulatory with symptoms. Detailed demographic information is presented in Table 1.

2.2. Data analysis

Only 92 unique fatigue-related items were analyzed. General population parameters (as opposed to cancer-specific parameters) were used to anchor the nine core fatigue items. We took this approach so that we may expand the applicability of the produced item bank to other chronic illness populations, such as patients with arthritis, multiple sclerosis, and human immunodeficiency virus (HIV) infection. Differential item functioning (DIF) of these items was examined across two U.S. population-based samples (detailed sample information is discussed in Lai et al. [21]). No DIF was found among these nine items, confirming the location stability of these nine core items.