Original Article

Validation of the Taiwanese Version of the Brief Fatigue Inventory

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Abstract
We validated the Taiwanese version of the Brief Fatigue Inventory (BFI-T) in a sample of 439 Taiwanese patients with multiple cancer diagnoses. Internal consistency was indicated by Cronbach alphas of 0.96 for fatigue-related severity and 0.95 for interference. Test-retest reliability was 0.89 for fatigue severity and 0.91 for interference. Factor analysis revealed a one-factor structure. Convergent validity was examined by correlating the BFI-T worst fatigue and fatigue severity composite scores with POMS vigor and fatigue subscales scores. Known-group validity was established by comparing BFI-T worst fatigue and severity composite scores between patients with low functional status and high functional status and between inpatients and outpatients. The BFI-T's sensitivity was examined by comparing BFI-T severity and interference composite scores before, during, and after chemotherapy treatment in a subsample of 20 breast cancer patients. The BFI-T is reliable, valid, and sensitive for measuring cancer-related fatigue severity and interference among Taiwanese cancer patients. J Pain Symptom Manage 2006;32:52–59. © *2006 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.*

Key Words
Fatigue, validation, reliability, validity, sensitivity, Brief Fatigue Inventory

Introduction

Fatigue is the most common symptom or complaint related to cancer and cancer therapy[1] and has been identified as the most distressful symptom for cancer patients.[2] Cancer-related fatigue not only interferes with daily activity, but also has a great impact on quality of life.[3] Cancer-related fatigue has been shown to affect up to 90% of cancer patients.[2,4] Because fatigue is a subjective experience, assessment of fatigue will rely heavily on patient self-report. Effective management of fatigue is hampered by the lack of a well-validated, sensitive, and easily administered measurement tool. In Taiwan, no measure of cancer-related fatigue has been specifically developed for cancer patients. Therefore, the purpose of this study was to validate the

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Taiwanese version of the Brief Fatigue Inventory (BFI-T) in a sample of Taiwanese cancer patients.

Previous studies have varied in their reports of the prevalence of fatigue in cancer patients. For example, between 58% and 90% of patients receiving cancer therapy have reported experiencing fatigue.[5–8] The reported prevalence of fatigue in patients with advanced cancer has ranged from 51% to 89%.[9–12] These variations in prevalence rate and the difficulties in interpreting these results could be due to the lack of a widely accepted definition of fatigue and a well-validated measurement. Moreover, it is not clear whether fatigue is different for cancer patients than it is for healthy populations or patients with diseases other than cancer.[13]

Fatigue is a subjective symptom and is generally thought to be related to feelings of weakness, tiredness, and lack of energy. Fatigue was assessed in previous studies by single items in a symptom checklist or in quality-of-life measures.[14] In recent years, a number of more comprehensive fatigue self-report measures have been developed, including a) unidimensional scales, which may include either single or multiple items, and b) multidimensional scales. The Rhoten Fatigue Scale,[15] the fatigue subscale of the Visual Analogue Scale,[16] and the fatigue subscale of the Profile of Mood States (POMS)[17] are examples of unidimensional scales. These scales are usually short and easily administered; however, they do not take into account the multifactorial nature of fatigue, especially its interference with daily life. Examples of multidimensional scales include the Piper Fatigue Scale,[18] the Fatigue Symptom Checklist,[19] the Multidimensional Fatigue Inventory,[20] and the Fatigue Symptom Inventory.[21] Many of the multidimensional scales have been developed from a theoretical base; however, their length and the time required to complete them makes them impractical to use in clinical screening or clinical evaluation.

The BFI[22] was specifically developed to measure fatigue in cancer populations. The BFI has been translated into a variety of languages (e.g., Chinese, Japanese, and German) and the psychometric properties have been established.[23–25] Validation of the BFI-T will provide a valid tool to rapidly screen cancer-related fatigue in Taiwanese cancer patients and will allow study results to be compared across different countries. Therefore, the purpose of this study was to establish the psychometric properties of the BFI-T, including validity, reliability, and sensitivity, in a sample of Taiwanese cancer patients.

Methods

Participants and Settings

A cross-sectional and descriptive correlational design was used in this study. A convenience sample was recruited from outpatient oncology clinics and oncology inpatient units at two medical centers in southern Taiwan and two medical centers in northern Taiwan. Selection criteria required that patients have a pathological diagnosis of cancer, be at least 18 years old, and be able to communicate in Mandarin or Taiwanese. Patients were excluded if they were cognitively impaired, if they refused to participate, or if they could not understand the intent of this study. The final sample of 439 patients included 235 inpatients and 186 outpatients.

The study was approved by the Institutional Review Board of Taipei Medical University in Taiwan, and the University of Texas M. D. Anderson Cancer Center in Houston.

Instruments

A four-part survey was used to collect data. The questionnaires included a) the BFI-T, b) the POMS, c) the Karnofsky Performance Status (KPS), and d) a demographic questionnaire.

The BFI. The original BFI was developed at The University of Texas M. D. Anderson Cancer Center to measure fatigue in cancer patients. The BFI uses a 0–10 scale to measure fatigue severity and interference with life activities in the previous 24 hours. The first part of the BFI measures worst fatigue during the past 24 hours, usual fatigue during past 24 hours, and fatigue now, with each item rated from 0 (no fatigue) to 10 (fatigue as bad as you can imagine). A composite fatigue severity score is the average of the three severity items. The second part of the BFI assesses the extent to which fatigue interferes with general activities, mood, walking, normal work, relations

with other people, and enjoyment of life, with each item rated on a scale of 0 (does not interfere) to 10 (completely interferes). A composite fatigue interference score is the average of the six interference items. The validity and reliability of the BFI have been established.[22]

The BFI-T was developed by using a translation and back-translation process. The BFI was first translated from English into Taiwanese by a bilingual person. A second bilingual person who had not seen the original English version back-translated from Taiwanese into English. The two English translations were then compared for consistency. If the back-translated items and the originals did not agree, the first translator attempted a second translation, which was then compared to the original. This process was repeated until the back-translated items and the originals agreed.

POMS Short Form. The Taiwanese version of the POMS short form[17] was used to assess the patient's mood states. The POMS short form consists of 30 items (based on the 65-item questionnaire in the long form) and contains the same six scales measured by the long form: tension, depression, anger, fatigue, confusion, and vigor. A composite score, total mood disturbance (TMD), is computed by summing each of the individual scores for tension, depression, anxiety, fatigue, and confusion, with vigor scores subtracted to indicate patients' TMD. Each item of the POMS short form is scored on a 5-point Likert scale ranging from 0 (not at all) to 4 (extremely). Reliability (Cronbach alpha) ranged from 0.75 to 0.95 for an outpatient sample.[17] For this study, the fatigue and vigor subscales were used. Cronbach alphas for the fatigue and vigor subscales of the POMS were 0.91 and 0.92, respectively.[26]

Karnofsky Performance Status. The KPS was used to assess patients' performance status. The KPS is rated on a scale of 0–100, in steps of 10, with 0 indicating dead and 100 indicating no complaints and no evidence of disease. The KPS has been documented to have good predictive validity.[27]

Questionnaire for Demographic and Disease Information. A demographic information sheet covered basic patient information such as age, sex, education level, marital status, religious belief, and occupation. A disease information sheet covered a patient's diagnosis, medications, and treatment status, and whether or not metastasis had occurred.

Statistical Analysis

The reliability and validity of the BFI-T were evaluated as follows. The *internal consistency* was established by calculating the Cronbach alpha coefficient, which ranges from 0 to 1, with higher values indicating less measurement error. The *test-retest reliability* was evaluated by calculating the Pearson product moment correlation coefficient between pretest and post-test with a 3-day interval in a sample of 12 patients. *Construct validity* was established by factor analysis. *Convergent validity* was examined by calculating the Pearson product moment correlation coefficient between BFI-T scores (the worst fatigue item and the fatigue severity composite score) and POMS vigor and fatigue subscales scores. The Pearson product moment correlation coefficient between the BFI-T interference composite score and the KPS score was also computed. *Known-group validity* was established by comparing the BFI-T worst fatigue score and severity composite score between patients having low functional status (KPS score ≤ 50) and high functional status (KPS score > 50) and between inpatients and outpatients. We hypothesized that inpatients and patients with poor functional status would have more severe fatigue.

In addition to the reliability and validity analyses, we examined the BFI-T's sensitivity (its ability to make fine distinctions between objects) by comparing the BFI-T severity and interference composite scores before chemotherapy treatment, during treatment, and one week after treatment in a sample of 20 breast cancer patients. We hypothesized that patients would experience the most severe fatigue during treatment, less fatigue after treatment, and the least fatigue before treatment. Repeated-measure analysis of variance was used to examine this hypothesis.

All statistical procedures were performed using SPSS software, version 12 (SPSS, Inc.). The significance level was set at 0.05; all P values were two-tailed.

Table 1
Demographic and Disease-Related Characteristics ($n = 439$)

Characteristics	Mean	SD
Age (years)	58.74	13.69
Education (years)	7.18	5.03
KPS	67.03	21.04
	n	%
Sex		
Male	191	44
Female	248	57
Marital status		
Married	338	77
Other	101	23
Religious affiliation		
Buddhist and Taoist	356	81
Christian	35	8
None	48	11
Disease stage		
Localized	202	46
Metastasized	237	54
Recruitment sites		
Inpatient	253	58
Outpatient	186	42

SD = standard deviation.

Results

Participant Characteristics

Demographic and disease-related characteristics of patients are presented in Table 1. Fifty-seven percent of the participants were women. The mean (SD) age was 58.74 (13.69). The majority of participants were married (77%) and the mean (SD) years of education was 7.18 (5.02). Forty-nine percent of the participants were retired. The participants were diagnosed with various types of cancer, including breast (17%), colorectal (15%), lung (14%), gastric (8%), cervical (8%), nasopharyngeal (7%), liver (7%), oral (6%), ovarian (4%), and other (14%). Seventeen percent of participants were receiving chemotherapy and 14% were receiving radiotherapy. Among participants, 54% had metastatic cancer. Forty-two of participants were outpatients and 58% were inpatients. The mean (SD) KPS score was 71.8 (5.02).

Internal Consistency

Internal consistency was established by calculating Cronbach alpha coefficients, which were 0.96 for the three fatigue severity items, 0.95 for the six fatigue interference items, and 0.97 for all nine items, indicating the good internal consistency of the BFI-T. The item-to-item correlation coefficients ranged from 0.60 to 0.93 for these nine items (Table 2).

Test-Retest Reliability

Test-retest reliability was evaluated by calculating the Pearson product moment correlation coefficient between pretest and post-test over a 3-day interval in a sample of 12 cancer inpatients. The test-retest reliability was 0.89 for the fatigue severity composite score and 0.91 for the interference composite score.

Construct Validity

Factor analysis was used to determine the underlying constructs measured by the items in the BFI-T. Principal axis factor analysis with oblimin rotation revealed a single underlying construct among the nine BFI-T items. The factor loadings were high and ranged from 0.80 to 0.94, which indicates the association of the nine BFI-T items with a single factor (Table 3).

Convergent Validity

The BFI-T scores (the worst fatigue item and fatigue severity composite score) were

Table 2
Item-to-Item Correlation Coefficients for the BFI-T ($n = 439$)[a]

	Fatigue Now	Fatigue Usual	Fatigue Worst	General Activity	Mood	Walking	Work	Relations	Enjoyment
Fatigue now	1	—	—	—	—	—	—	—	—
Fatigue usual	0.93	1	—	—	—	—	—	—	—
Fatigue worst	0.88	0.91	1	—	—	—	—	—	—
General activity	0.82	0.83	0.85	1	—	—	—	—	—
Mood	0.75	0.73	0.68	0.66	1	—	—	—	—
Walking	0.76	0.78	0.80	0.90	0.60	1	—	—	—
Work	0.78	0.81	0.84	0.90	0.67	0.86	1	—	—
Relations	0.69	0.68	0.63	0.68	0.80	0.63	0.65	1	—
Enjoyment	0.71	0.74	0.77	0.85	0.65	0.84	0.85	0.69	1

[a]All $P < 0.05$.

Table 3
Factor Loadings of the BFI-T ($n = 439$)

	Factor Loading
Fatigue now	0.92
Fatigue usual	0.93
Fatigue worst	0.92
General activity	0.94
Mood	0.81
Walking	0.90
Work	0.92
Relations	0.80
Enjoyment	0.87

significantly correlated with the scores of the vigor and fatigue subscales of the POMS (Table 4). The results supported the hypothesis that the BFI-T severity scores correlate with the fatigue construct measured by the POMS. The Pearson product moment correlation between the BFI-T interference composite score and the KPS score was statistically significant ($r = -0.57$, $P < 0.05$) (Table 4).

Known-Group Validity

As we hypothesized, patients with lower functional status (KPS score ≤ 50) reported significantly higher levels of fatigue severity and interference than patients with higher functional status (KPS score > 50). Similarly, inpatients reported significantly increased levels of fatigue severity and interference (Table 5).

Sensitivity

We examined the sensitivity of the BFI-T in a sample of 20 breast cancer patients receiving chemotherapy. As we hypothesized, post hoc Sheffe test revealed that patients reported the highest BFI-T fatigue severity and interference scores during chemotherapy treatment, followed by one week post-treatment, followed by pretreatment (Table 6).

Table 4
Correlation between BFI-T and POMS and KPS ($n = 439$)

	POMS-Fatigue	POMS-Vigor	KPS
Fatigue worst	0.82[a]	−0.69[a]	—
Fatigue severity	0.87[a]	−0.71[a]	—
Fatigue interference	—	—	−0.57[a]

[a] $P < 0.05$.

Discussion

This study demonstrated that the BFI-T has good reliability, validity, and sensitivity. The reliability was supported by good internal consistency, as demonstrated by the Cronbach alpha and test-retest coefficients. The validity was supported by good known-group validity and convergent validity. Inpatients and patients with poor KPS scores reported higher BFI-T scores, indicating known-group validity. The BFI-T scores correlated well with another established measure of fatigue (the POMS fatigue and vigor subscales), indicating convergent validity. The sensitivity of the BFI-T was established by the fact that BFI-T scores changed significantly across different chemotherapy stages. The psychometric properties of the BFI-T are consistent with the English,[22] Chinese,[23] and Japanese[24] versions of the BFI. The BFI-T is one of few instruments measuring fatigue in Taiwanese cancer patients that has shown excellent reliability and validity.

Fatigue is an important and common complaint in cancer patients both during and after treatment,[13] and is one of the most common symptoms of hepatocellular carcinoma patients admitted to the hospice unit in Taiwan.[28] In this study, 69.2% of patients reported significant fatigue in the past week, which indicates that it is quite common for Taiwanese cancer patients to experience fatigue. This result is consistent with other studies. In a sample of 157 lung cancer patients in Japan, Okuyama et al.[29] found that 59% of patients experienced clinical fatigue that interfered with daily activity. Irvine et al.[5] found that in a sample of cancer patients receiving chemotherapy or radiotherapy, the prevalence of fatigue among cancer patients after undergoing treatment was 61%. In another study, 58% of a sample of cancer patients receiving cancer therapy reported that fatigue had affected them in the past month, and that fatigue affected them significantly more than any other cancer symptom.[6] Moreover, another study reported that up to 75% of advanced-cancer patients experienced significant fatigue.[9] These results confirm that fatigue is a prevalent symptom related to cancer and cancer therapy. However, unlike the great attention to and successful advances in the management of cancer pain, there has been a lack of interest in fatigue as

Table 5
Mean (SD) of BFI-T between Low vs. High Functional Status (KPS) and Inpatients vs. Outpatients

	Low KPS	High KPS	*t*	*P* value
Fatigue worst	6.49 (3.66)	4.92 (3.40)	4.24[a]	<0.001
Fatigue severity	5.51 (3.30)	3.99 (2.83)	4.79[a]	<0.001
Fatigue interference	5.72 (3.50)	3.18 (2.82)	7.88[a]	<0.001
	Outpatients	Inpatients	*t*	*P* value
Fatigue worst	4.89 (3.21)	5.70 (3.74)	2.40[a]	0.01
Fatigue severity	3.97 (2.65)	4.74 (3.26)	2.62[a]	0.009
Fatigue interference	3.04 (2.70)	4.50 (3.45)	4.80[a]	<0.001

[a] $P < 0.05$.

a topic for research, which has been attributed to the lack of any effective treatment strategy.[30] Therefore, more research efforts should be directed toward mechanisms, etiology, and management strategies of cancer-related fatigue.

Another reason for the lack of interest in research on cancer-related fatigue is the lack of validated and clinically easy-to-use assessment tools.[13] The BFI-T, however, has several advantages that would make it useful for measuring fatigue. In this study, the BFI-T was demonstrated to have good psychometric properties, which makes it an excellent measurement tool for research and clinical assessment in Taiwanese cancer patients. Because the BFI-T has only nine very straightforward items, most of the patients in our study were able to complete it in about 5 minutes, with very few missing data. The BFI-T's 0–10 rating scale is consistent with most of the measurement scales in Taiwan, and is, therefore, easy for Taiwanese patients of all education levels and social statuses to understand.

Similar to pain, fatigue is commonly conceptualized as a multidimensional sensation that incorporates sensory, cognitive, affective, behavioral, and physiologic components.[31] However, unlike pain, no universally accepted definition or set of well-conceptualized dimensions for fatigue have been proposed.[32,33] Although a multidimensional measurement may be desired, the multidimensional scales may be too long for fatigued patients to complete and thus not feasible for clinical use. Even for the purpose of clinical research, instruments with too many items may result in missing data because of limited energy and time of cancer patients. Although the BFI-T does not capture the multiple dimensions of fatigue, it is sufficient to screen for patients with high levels of fatigue; additional assessments to determine the other dimensions of fatigue can then be performed. Because the BFI-T measures a single construct, the mean of the nine BFI-T items can be used as a global BFI-T score for representing levels of fatigue. The BFI-T has excellent known-group validity, which can accurately discriminate between patients with high levels and low levels of fatigue. This was exemplified in the groups of inpatients, patients with low KPS performance status, and patients with cancer metastasized who reported significantly higher BFI-T scores than outpatients, patients with high KPS performance status, and patients with localized cancer, respectively. Moreover, the good sensitivity of the BFI-T allowed this tool to detect changes in levels of fatigue in cancer patients. Therefore, the BFI-T can be used as a first-line screening tool in clinical practice for Taiwanese patients with cancer-related fatigue.

Table 6
Repeated-Measure Analysis of Mean (SD) of the BFI-T across Different Chemotherapy Stages ($n = 20$)

	Before Treatment 1		During Treatment 2		After Treatment 3			
	Mean	(SD)	Mean	(SD)	Mean	(SD)	*F*	Sheffe Comparison
Fatigue severity	5.05	1.53	7.70	1.53	6.78	1.38	43.45[a]	2 > 3 >1
Fatigue interference	4.12	2.53	6.59	2.03	5.77	2.18	23.10[a]	2 > 3 >1

[a] $P < 0.05$.

The results from this study should be interpreted with caution because of certain limitations. First, we had no normal control group to differentiate between the severity of cancer-related fatigue and non-cancer-related fatigue. Future research that compares severity of fatigue across different diagnostic groups or demographic characteristic groups may provide more understanding about the nature of fatigue. Second, the sample size for examining the test-retest reliability was small. A larger sample may be needed to re-examine the test-retest reliability. Third, we performed no physiological measures (e.g., hemoglobin levels or nutritional status) in this study. These measures could have provided objective data to go along with the subjective measure of the BFI-T.

In conclusion, the findings from this study supported that the BFI-T is a reliable, valid, sensitive, and clinically easy-to-use measurement of fatigue in Taiwanese cancer patients. Moreover, the BFI-T is a comprehensive measure that not only assesses the severity of fatigue, but also evaluates the extent to which fatigue interferes with daily life. Because the BFI has been translated into many other languages besides English, including Chinese, Japanese, German, and Korean, it allows for cross-cultural comparisons of study results from different countries.

Fatigue has become the most frequent symptom experienced by cancer patients. The use of a reliable, valid, simple, and easily administered tool can improve communication about fatigue between patients and clinicians, and thus has great potential to improve the management of cancer-related fatigue.

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