ABSTRACT

Background: The Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-Fatigue) instrument is a fatigue measure widely used on patients with cancer worldwide. The psychometric quality of the Korean version of the FACIT-Fatigue instrument has never been systematically evaluated.

Purpose: The purpose of this study was to assess the reliability and validity of the Korean version of the FACIT-Fatigue instrument.

Methods: This study used data collected from 170 patients with cancer and 120 healthy individuals. Internal consistency reliability was analyzed using Cronbach’s α and item–total correlation. Construct validity was analyzed using confirmatory factor analysis, and known-group validity was tested using t tests. Convergent validity was analyzed using Pearson’s correlation with pain and functional limitations. Predictive validity was analyzed using receiver operating characteristic curves.

Results: The Cronbach’s α was .93 for the reliability evaluation, and the item–total correlation ranged from .27 to .84. In the construct validity evaluation, the bifactor model showed good fit (Q = 1.93, comparative fit index = .97, Tucker–Lewis index = .96, root mean square error of approximation = .05), indicating using the instrument’s total score to be more appropriate than using the subscale scores (explained common variance = .76, ωH = .95, ωV = .85, ωV/H = .89). The group of patients with cancer showed significantly higher fatigue than the healthy subject group, showing known-group validity (t = −10.40, p < .05). Fatigue showed significant and strong correlations with functional limitations and pain (all ps < .001). The area under the curve was .81 (cutoff point = 40, Youden’s index: 0.47, sensitivity: 77.60%, specificity: 73.04%), verifying that the instrument is predictive of higher fatigue severity in patients with cancer.

Conclusions/Implications for Practice: The Korean version of the FACIT-Fatigue instrument was shown to be reliable and valid. Its construct validity supports the use of the total scale score rather than the subscale scores.

Key Words: cancer, fatigue, oncology, psychometrics, validity.

Introduction

Cancer is a prevalent disease worldwide. According to a report by the Organization for Economic Cooperation and Development (2021), the average incidence rate of cancer is 294 per 100,000 population, and cancer is the second most common cause of death in Organization for Economic Cooperation and Development member countries. The incidence rate in Korea is also high at 243 per 100,000, with cancer ranking as the most prominent cause of death in the country (27.0%; Statistics Korea, 2021).

Fatigue is one of the most commonly occurring subjective symptom in patients with cancer (Berger et al., 2020) and may be associated with either the cancer itself or related treatments and often does not improve with rest (Cella et al., 2002). Severe fatigue has been shown to impair physical function, reduce quality of life, delay treatment, and increase mortality (Mai et al., 2019). Thus, accurate and efficient fatigue assessment is essential for the successful completion of cancer treatment and improvement of survival rates in patients with cancer.

Fatigue in patients with cancer is often assessed using self-report questionnaires that employ either a unidimensional scale or a multidimensional scale. Examples of questionnaires featuring unidimensional scales include the Profile of Mood States Fatigue (McNair et al., 1992), the Brief Fatigue Inventory (Mendoza et al., 1999), and the Fatigue Severity Scale (Krupp et al., 1989). Examples of widely used multidimensional scales include the Piper Fatigue Scale (Piper et al., 1989), the Multidimensional Fatigue Symptom Inventory (Stein et al., 2004), and the Multidimensional Fatigue Inventory-20 (Smets et al., 1995). Unidimensional fatigue scales measure fatigue severity only and, as a result of their brevity, are well suited to clinical settings (Aghdam et al., 2019). In contrast, multidimensional scales measure various...
aspects of fatigue, addressing not only fatigue severity but also the impact of fatigue on physical function and socio-affective functions.

The Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-Fatigue) instrument was developed to measure fatigue in patients with cancer (Yellen et al., 1997). This instrument has been used worldwide in research on patients with cancer (Meyssam et al., 2017) and other chronic diseases (Cella et al., 2019; Çinar & Yava, 2018; Eek et al., 2019). Although the items of this instrument were generated based on the multidimensional concept of fatigue (i.e., fatigue severity and its impact on functions), its multidimensionality has not been confirmed in prior studies and, thus, the use of its subscales has yet to be scientifically justified (Cella et al., 2011; Montan et al., 2018). Although three models (one-factor, two-factor, and bifactor) have been tested in previous studies, none met their model-fit criteria, particularly in the samples of patients with cancer (Cella et al., 2011). Thus, researchers have tentatively concluded that it is more valid to consider the instrument as a unidimensional scale based on findings regarding the scale’s model fit indices, factor loadings, and reliability index (Montan et al., 2018). This indicates that a definite conclusion is needed regarding the dimensionality of this instrument.

The FACIT-Fatigue instrument was originally developed in English (Yellen et al., 1997) and has been translated into various languages, including Persian (Meyssam et al., 2017), Turkish (Çinar & Yava, 2018), and German (Montan et al., 2018). The FACIT-Fatigue instrument was translated into Korean by a test developer and has been used in previous research (S. H. Kim et al., 2017). However, there have been no evaluations of the reliability and validity of the Korean version of this instrument. To ensure accurate identification of fatigue, it is essential to validate the instrument systematically in different linguistic and cultural settings.

Considering the above, this study was designed to evaluate the reliability (internal consistency reliability) and validity (construct validity, convergent validity, known-group validity, and predictive validity) of the Korean version of the FACIT-Fatigue instrument by applying it to a sample of Korean patients with cancer. We evaluated the developer-translated Korean version of the scale. The known-group validity and predictive validity were evaluated by comparing the fatigue level of patients with cancer to the fatigue level of healthy subjects. The convergent validity was established using the associations with theoretically related constructs. The pain and functional limitations were used as the criteria to assess convergent validity. Although pain and functional limitations are distinct from fatigue, these two concepts have been reported to be associated with fatigue level in patients with cancer. In addition, pain has been shown to be correlated with fatigue (Lai et al., 2011) and has been postulated as a contributing factor to fatigue in patients with cancer (Berger et al., 2020; Ma et al., 2020). Patients with cancer often complain of functional limitations as a result of fatigue, and functional limitations can also cause fatigue or prolong its duration (Berger et al., 2020). Furthermore, although the directional relationships between fatigue and, respectively, pain and functional limitations in the current literature are inconclusive, it is clear that functional limitations and pain occur with fatigue concurrently. Thus, pain and fatigue have been adopted as criteria in convergent validity evaluations of the FACIT-Fatigue instrument in previous studies (Lai et al., 2011) and were used in this study. The level of fatigue in patients with cancer has been evaluated to be higher than that in healthy individuals, and thus, the known-group validity compared with the general population is an important component in validity evaluations of the FACIT-Fatigue instrument (Cella et al., 2002).

### Methods

#### Study Design and Sample

This study is a secondary analysis of data that were originally collected to develop and evaluate an instrument for measuring cognitive impairment in patients with cancer (H.-J. Kim & Barsevick, 2019). Primary data were collected from patients with cancer and healthy individuals from January 2012 to October 2016. The patient data were collected in outpatient and inpatient settings at a university hospital (the Catholic University of Korea) in Seoul, South Korea. The inclusion criteria were (a) adult patients (≥ 18 years old), (b) having diagnosed with any type of cancer, (c) receiving or planning to receive intravenous chemotherapy or biotherapy, and (d) being capable of reading and speaking Korean. Patients with neuropsychiatric disorders were excluded. The patient data were collected in the primary study at two time points, with baseline data collected on the day of or the day before the scheduled chemotherapy infusion. For those receiving cyclic treatment, the follow-up data were collected after at least one chemotherapy cycle, whereas for those with hematologic cancer (e.g., leukemia, lymphoma), these data were collected after they had completed 1 week of continuous chemotherapy. For the entire patient group, the follow-up time was 3–7 days after chemotherapy infusion. Only the data from the follow-up time point were used in this study, as all patients had received at least one cycle of chemotherapy (which may result in fatigue) at this point. Two hundred forty-nine patients were recruited for the primary study, of whom 186 provided follow-up data. Cases with missing FACIT-Fatigue data (n = 16) were excluded from analysis. Thus, the final sample was composed of 170 individuals.

The data for the healthy subject group were collected from a conveniently selected high school or middle school. The inclusion criteria were (a) adult teachers or staff in the selected settings (aged ≥ 18 years), (b) no experience of cancer diagnosis or treatment, and (c) capable of reading and speaking Korean. Persons with neuropsychiatric disorders were excluded. One hundred twenty healthy participants were enrolled for the healthy subject group, with none excluded.
Measurements

Functional assessment of chronic illness therapy-fatigue
The Korean version of the FACIT-Fatigue instrument (Version 4; Yellen et al., 1997) is composed of 13 items, with five items (Items 1–4 and 7) measuring fatigue experience and eight items (Items 5, 6, and 8–13) measuring the impact of fatigue on activities of daily living. Each item is scored using a 5-point Likert scale (0 = not at all, 4 = very much), and potential total scores range from 0 to 52. To calculate the total score, in accordance with the developer’s guidelines, reverse-scoring was used for all of the items except for the two positively stated items (Item 7: “I have energy” and Item 8: “Able to perform usual activities”). Higher total scores were indicative of lower perceived fatigue. At the time of scale development, the Cronbach’s α was .95 in a sample of U.S. patients with cancer (Cella et al., 2002).

Brief pain inventory-severity
The Brief Pain Inventory-severity measure (BPI-severity; Cleeland & Ryan, 1994), a subscale of the BPI, was designed to measure respondents’ pain within the past week using four items (“worst pain,” “least pain,” “average pain,” and “current pain”) that are scored using an 11-point scale (range: 0 = no pain to 10 = as bad as you can imagine). The reliability of the Korean version of the BPI-severity measure was previously evaluated in a sample of patients with cancer (Cronbach’s α of .85; Yun et al., 2004). In this study, the Cronbach’s α of the BPI-severity was .91.

Functional limitations: modified interference subscale of the brief pain inventory
The modified interference subscale of the BPI (BPI-interference) was originally developed to measure the extent of pain-related functional limitations (Cleeland & Ryan, 1994). For primary data collection (i.e., the source of the data used in this study), the instrument was modified to assess the impact of overall symptoms. BPI-interference is composed of seven items designed to assess how much, during the past week, symptoms have interfered with activities of daily living, mood, walking, working, sleep, interpersonal relationships, and enjoyment of life, respectively, with answers given using an 11-point scale (range: 0 = no interference to 10 = complete interference). The reliability of the Korean version of the BPI-interference was previously evaluated in a sample of patients with cancer (Cronbach’s α of .93; Yun et al., 2004). The Cronbach’s α for the functional limitation items in this study was .95.

Statistical Analysis
The data were analyzed using IBM SPSS Statistics 25.0 (IBM Inc., Armonk, NY, USA) and AMOS 22.0 (Chicago, IL, USA). Internal consistency was analyzed using Cronbach’s alpha and item–total correlation, and construct validity was analyzed using confirmatory factor analysis (CFA). All three model types (i.e., one-factor model, two-factor model, and bifactor model) were evaluated using CFA based on the model fit criteria. Model fit was assessed using the criteria χ² test (p > .05), Q statistic (χ²/df; Q ≤ 3.0), comparative fit index (≥ .9), Tucker–Lewis index (≥ .9), and root mean square error of approximation (≤ .10; Schumacker & Lomax, 2016). Because of the high sensitivity of the χ² test to sample size and to the distribution of the observed variable (Schumacker & Lomax, 2016), all other fit indices were considered when selecting the final model.

Convergent validity was analyzed using Pearson’s correlation with pain and functional limitations. Known-group validity was analyzed using a t test to assess the difference in fatigue between the two groups. Predictive validity, which reflects the ability to predict different levels of fatigue among patients with cancer when compared with healthy individuals, was analyzed using receiver operating characteristic analysis. In the receiver operating characteristic analysis, area under the curve (AUC), sensitivity, and specificity were evaluated. The optimal cutoff point, which was applied in this study to identify the meaningful level of fatigue in patients with cancer, was determined based on Youden’s index as the point perpendicularly farthest from the reference line (AUC = .5; Youden, 1950). All statistical analyses were performed using two-tailed tests, with the significance level set to .05. The sample size for this study (N = 170) satisfied the sample size of 130 that was recommended for CFA by Schumacker and Lomax (2016).

Ethical Considerations
The institutional review board of the Catholic University of Korea approved the study protocol (MC18EESI0093). Informed consent was obtained from all of the participants.

Results

Subjects’ Characteristics
The group of patients with cancer was composed of 170 participants. The mean age of the participants in this group was 50.9 years (range: 18–85 years); 60.6% were female, 82.9% were married, 46.5% had an educational level of college or higher, and 32.1% had a comorbid disease. In terms of cancer type, breast cancer (49 patients, 28.8%) and blood cancers (lymphoma or leukemia; 63 patients, 37.1%) were most common, whereas other common cancer types included colorectal (24 patients, 14.1%) and lung (18 patients, 10.6%).

The healthy subject group was composed of 120 participants. The mean age of the participants in this group was 44 years (range, 18–85 years); 57.5% were female, 73.1% were married, 84.2% had an education level of college or higher, and 22.5% had a comorbid disease (most commonly hypertension or diabetes).
Item Analysis and Reliability of the Korean Version of the Functional Assessment of Chronic Illness Therapy-Fatigue Instrument for Patients With Cancer

Before assessing the reliability and validity of this instrument, we checked whether its distribution (mean, standard deviation, skewness, and kurtosis) was suitable for data analysis (Table 1). The mean total score was 30.47 (range: 2–51), and the mean scores for each item ranged between 1.46 and 2.98. The skewness of each item ranged between −.92 and −.04, which met the quality criterion (< |3|), and the kurtosis ranged between −1.08 and −0.10, which also satisfied the quality criterion (< |10|; Kline, 2016). In the reliability assessment, the item–total correlation ranged from .27 to .84. All of the items met the quality criterion for item–total correlation assessment (higher than .20, as suggested by DeVellis, 2016), and thus, all of the items were evaluated as suitable. Regarding internal consistency reliability (Table 1), the Cronbach’s α was .93, which is higher than the quality criterion of .90 (DeVellis, 2016). When each item was deleted one at a time, the Cronbach’s α (the α of the deleted item) ranged from .92 to .94, indicating that no single item had a major effect on internal consistency reliability.

Determining Construct Validity Using Confirmatory Factor Analysis

CFA, used to evaluating construct validity, was performed sequentially for a one-factor model, a two-factor model, and a bifactor model. This approach was adopted because all three models were conceptually possible and had been evaluated in previous factor analyses of the FACIT-Fatigue instrument (Cella et al., 2011; Montan et al., 2018). The two-factor model was evaluated because the test developer proposed two definable subfactors: “fatigue experience” (Items 1–4 and 7) and “fatigue impact” (Items 5, 6, and 8–13; Cella et al., 2011). The bifactor model is composed of (a) a theoretical general factor explaining the commonality of the instrument (i.e., overall fatigue in the case of FACIT-Fatigue) and (b) subfactors explaining the variance, independent of the general factor (i.e., fatigue experience and fatigue impact in the case of FACIT-Fatigue; Rodriguez et al., 2016b).

The one- and two-factor models did not satisfy the model fit criteria. However, the bifactor model did satisfy the model fit criteria and was consequently selected as the final model: χ² = 100.40 (p > .05), df = 52, Q statistics = 1.93, comparative fit index = .97, Tucker–Lewis index = .96, root mean square error of approximation = .05 (95% confidence interval [.04, .07]). The relevance of the bifactor model was evaluated based on the following: (a) the standard factor loading (> .3), (b) ω index (model-based reliability coefficient), (c) ω_total (total score variance attributable to the general factor), (d) ω_sub (variance attributable to the subfactors), (e) ω_f (variability of subfactors after controlling for the variance explained by the general factor), (f) the ratio of ω_f and ω (the impact of the general factor on reliability), and (g) explained common variance (ECV; the explanatory power of the general factor; DeVellis, 2016; Gu et al., 2017; Rodriguez et al., 2016a). Generally, a measure is considered unidimensional when ω is higher than

Table 1

Descriptive Statistics and Internal Consistency Reliability of the Korean Version of FACIT-Fatigue for the Group of Patients With Cancer (N = 170)

| Item No. | Item Description | Mean | SD  | Skewness | Kurtosis | ITC | α/Item Deleted α |
|---------|-----------------|------|-----|----------|----------|-----|------------------|
| Total   |                 | 30.47| 11.19| −.38     | −.58     | NA  | .93              |
| 1       | Feel fatigued a | 2.47 | 1.15 | −.27     | −.97     | .76 | .92              |
| 2       | Feel weak a     | 2.33 | 1.13 | −.18     | −.96     | .80 | .92              |
| 3       | Feel listless a | 2.44 | 1.24 | −.26     | −1.04    | .78 | .92              |
| 4       | Feel tired a    | 2.08 | 1.08 | −.04     | −.86     | .75 | .92              |
| 5       | Trouble starting things a | 2.37 | 1.20 | −.16     | −1.08    | .84 | .92              |
| 6       | Trouble finishing things a | 2.42 | 1.20 | −.25     | −.97     | .80 | .92              |
| 7       | Have energy     | 1.46 | 0.90 | −.07     | −.53     | .27 | .94              |
| 8       | Able to do usual activities | 2.46 | 1.04 | −.26     | −.44     | .42 | .93              |
| 9       | Need sleep during the day a | 2.41 | 1.23 | −.42     | −.97     | .51 | .93              |
| 10      | Too tired to eat a | 2.98 | 1.16 | −.92     | −.09     | .62 | .93              |
| 11      | Need help for usual activities a | 2.81 | 1.18 | −.76     | −.31     | .76 | .92              |
| 12      | Frustrated by tiredness a | 2.74 | 1.27 | −.71     | −.61     | .77 | .92              |
| 13      | Limit social activities a | 2.43 | 1.31 | −.39     | −1.04    | .81 | .92              |

Note: FACIT-Fatigue = Functional Assessment of Chronic Illness Therapy-Fatigue instrument; ITC = item–total correlation; NA = not applicable. a Reverse scored.
Table 2
Construct Validity Based on the Confirmatory Factor Analysis on the Group of Patients With Cancer (N = 170)

| Item No. | FACIT-Fatigue Items | General Factors: Overall Fatigue | Subfactor 1: Fatigue Experience | Subfactor 2: Fatigue Impact |
|----------|---------------------|---------------------------------|---------------------------------|-----------------------------|
| 1        | Feel fatigued       | .71                             | .56                             |                             |
| 2        | Feel weak           | .74                             | .60                             |                             |
| 3        | Feel listless       | .73                             | .52                             |                             |
| 4        | Feel tired          | .76                             | .34                             |                             |
| 5        | Trouble starting things | .16                          | .12                             |                             |
| 6        | Trouble finishing things | .97                          | .13                             |                             |
| 7        | Have energy         | .93                             | .14                             |                             |
| 8        | Able to do usual activities | .33                          | −.26                            |                             |
| 9        | Need sleep during the day | .52                          | −.15                            |                             |
| 10       | Too tired to eat    | .54                             | −.42                            |                             |
| 11       | Need help for usual activities | .71                          | −.40                            |                             |
| 12       | Frustrated by tiredness | .72                          | −.54                            |                             |
| 13       | Limit social activities | .80                          | −.39                            |                             |
| ω for the overall model | .95                      |                                 |                                 |                             |
| ω₁ for the general factor, ωₛ for the subfactors | .85                      | .90                             | .92                             |
| ω₁ₛ for the subfactors |                                 | .29                             | .10                             |
| ω₁/ω     | .89                             |                                 |                                 |                             |
| ECV      | .76                             |                                 |                                 |                             |

Note. In the bifactor model, Subfactor 1 includes Items 1–4 and 7, whereas Subfactor 2 includes the other items. Bolded data indicate the significant factor loadings. ECV = explained common variance; FACIT-Fatigue = Functional Assessment of Chronic Illness Therapy-Fatigue.

.Determining Convergent Validity Through the Association With Pain and Functional Limitations

The Korean version of the FACIT-Fatigue instrument showed significant correlations with pain (r = −.64, p < .001) and functional limitations (r = −.78, p < .001; Table 3). Negative correlations were because of the reverse scoring of the scale. Lower scores indicated higher fatigue, whereas higher scores for pain and functional limitations indicated more severe pain and functional limitations. Hence, the results supported an association between higher fatigue and, respectively, higher pain and higher functional limitations. In the by-item analysis, all items were found to be significantly correlated with functional limitations. Moreover, all of the items were also significantly associated with pain, with the exception of Item 7 (“I have energy”; r = −.07, p = .37).

Table 3
Concurrent Validity for the Group of Patients With Cancer (N = 170)

| Item No. | Korean Version of FACIT-Fatigue | Pain Severity (r) | Functional Limitation (r) |
|----------|---------------------------------|-------------------|---------------------------|
| 1        | Feel fatigued                   | −.64**            | −.78**                    |
| 2        | Feel weak                       | −.53**            | −.67**                    |
| 3        | Feel listless                   | −.57**            | −.65**                    |
| 4        | Feel tired                      | −.59**            | −.66**                    |
| 5        | Trouble starting things         | −.57**            | −.71**                    |
| 6        | Trouble finishing things        | −.52**            | −.64**                    |
| 7        | Have energy                     | −.07              | −.17*                     |
| 8        | Able to do usual activities     | −.35**            | −.41**                    |
| 9        | Need sleep during the day       | −.39**            | −.47**                    |
| 10       | Too tired to eat                | −.39**            | −.42**                    |
| 11       | Need help for usual activities  | −.54**            | −.64**                    |
| 12       | Frustrated by tiredness         | −.51**            | −.64**                    |
| 13       | Limit social activities         | −.47**            | −.68**                    |

Note. FACIT-Fatigue = Functional Assessment of Chronic Illness Therapy-Fatigue.
*p < .05. **p < .001.
Known-Group Validity and Predictive Validity Regarding Differentiating and Predicting Fatigue Among Patients With Cancer When Compared With Healthy Subjects

Known-group validity was tested to determine the difference between the two groups in terms of total fatigue score. The fatigue level in the group of patients with cancer (mean = 30.47 ± 11.19) was found to be more severe than that in the healthy group (mean = 42.04 ± 7.58; t = −10.40, p < .05). In the predictive validity evaluation, the AUC was found to be .81 (p < .001, 95% CI [.76, .86]). The optimal cutoff point for predicting the fatigue level of the group of patients with cancer when compared with the healthy group was 40 points (Youden’s index = .47, sensitivity = 77.60%, specificity = 73.04%, positive predictive value = 82.10%, negative predictive value = 67.20%).

Discussion

The purpose of this study was to analyze the reliability and validity of the Korean version of the FACIT-Fatigue instrument. To the best of the authors’ knowledge, this study was the first to evaluate the psychometric quality of this useful measure. The Korean version of the FACIT-Fatigue instrument was found to be a reliable and valid instrument for assessing fatigue in Korean patients with cancer.

Internal Consistency Reliability

Cronbach’s α for the scale was found to be .93, indicating that it is a highly reliable instrument in terms of internal consistency. This level of internal consistency is similar to those reported in studies that applied this scale in other language versions on, for example, patients with cancer (Meynsami et al., 2017), leukemia (Eek et al., 2019), Type 2 diabetes (Cinar & Yava, 2018), and rheumatoid arthritis (Cella et al., 2019). All of the α values reported in these studies were higher than .90.

Convergent Validity and Known-Group Validity

In convergent validity analysis, the Korean version of the FACIT-Fatigue instrument was strongly associated with worse pain and more functional limitations. The correlation levels (with pain: r = −.64, with functional limitations: r = −.78) met the convergent validity evaluation criterion of .5 suggested by Cohen (2013). These correlation levels are similar to those found in Lai et al.’s (2011) study, which studied patients with systemic lupus erythematosus (with pain: r = −.60, with functional limitations: r = −.72). In the known-group validity analysis, the Korean version of the FACIT-Fatigue instrument accurately reflected theoretically expected inter-group differences. This significant group difference of patients with cancer from the general population was also found in a previous validation study (Cella et al., 2002).

Construct Validity

In the construct validity evaluation, the bifactor model was found to be most suitable. As a bifactor model includes not only the general factor but also subfactors, it tends to present an improved explanation of the variance when compared with one-factor and two-factor models (Gu et al., 2017; Rodriguez et al., 2016b). Indeed, the bifactor model better explained the variance in the present data and showed a better fit to the data when compared with both the one-factor and two-factor models. Notably, the model evaluation criteria of the bifactor model provided important information in terms of the structure of the Korean version of the FACIT-Fatigue instrument. In other words, the general factor provided the dominant explanation for the total variance, whereas the contributions of the subfactors with regard to explaining the remaining variance and reliability were relatively minor (see the higher factor loadings on the general factor, higher ω_hc, lower ω_Hs, and higher ECV). Therefore, the Korean version of the FACIT-Fatigue instrument is more unidimensional than multidimensional. This finding is similar to those of Cella et al. (2011) and Montan et al. (2018), in that both of these studies supported the unidimensionality of the instrument. Thus, we concluded that using the total score of the Korean version of the FACIT-Fatigue instrument is more suitable than using its subscale scores, which accords with the conclusions of previous studies on the English and German versions of the FACIT-Fatigue instrument (Cella et al., 2011; Montan et al., 2018).

Predictive Validity

The AUC value of .81 shows that the Korean version of the FACIT-Fatigue instrument provides good predictive accuracy (Carter et al., 2016). This AUC value is similar to that reported in a previous study (.89), which aimed to predict fatigue among patients with anemic cancer (Cella et al., 2002). In that prior study, a cutoff point of 43 was used to distinguish fatigue in patients with anemic cancer from that of the healthy control group (sensitivity: 92%, specificity: 69%; Cella et al., 2002). The cutoff point used in this study (40 points) was lower, meaning a more severe fatigue level. This discrepancy may be because of differences in the sample. For example, although both this study and the previous study (Cella et al., 2002) included patients with hematologic cancer, the subjects in the previous study had not received chemotherapy. Thus, the cutoff point used in this study is more conservative.

Overall Evaluations of Items

In analyzing the reliability and validity of the instrument, two items (items 5 and 7) were found to have a relatively low psychometric quality. In the bifactor model, Item 5 (“trouble starting things”) earned a lower than .3 factor
loading to the general factor. Because there was little change in the Cronbach’s alpha when Item 5 was deleted, deletion of this item was not recommended. In the convergent validity analysis, the correlation between Item 7 (“have energy”) and pain severity was not significant (r = −.07, p > .05). The low quality of these items (Items 5 and 7) may result from cultural and linguistic differences in terms of how the items were interpreted in the Korean cultural context. Although the readability and face validity of the scale was evaluated and confirmed in a pilot study using 10 subjects, the potential cultural or linguistic issues of this scale were not systematically evaluated in this study. Nevertheless, this study finding indicates that some participants may face difficulties in interpreting the two items. Thus, we recommend conducting interviews with participants to choose more appropriate phrasings for Items 5 and 7.

**Limitations**

As the follow-up data in the primary study were not collected at a consistent time interval from the baseline, test–retest reliability was not evaluated in this study. Moreover, the concurrent validity, as shown using comparisons with the gold standard, was not evaluated because of the lack of other validated fatigue scales. Thus, future studies must investigate the test–retest reliability and concurrent validity of these scales. In addition, the two groups (patients with cancer and healthy participants) were not homogenous in terms of age, gender, and comorbidity distributions. The group of patients with cancer was slightly older and included more women and more individuals with comorbid conditions. After controlling for differences in terms of age, gender, and comorbid conditions using statistical analysis of covariance, the group differences in fatigue level were maintained (F = 101.86, df = 1, p < .001). Nevertheless, the differences in age and gender between the groups may have still confounded the findings for the known-group and predictive validity.

It is essential to establish a cutoff point to predict and identify fatigue in patients with cancer. However, few studies have sought to derive cutoff points for the FACIT-Fatigue instrument, which makes a comparison of the results difficult. In the future, we propose that, to accurately assess the predictive validity of the instrument, the optimal cutoff point, sensitivity, and specificity should be evaluated after recruiting a larger and more diverse sample.

**Conclusions**

Fatigue is an important outcome indicator when caring for patients with cancer, and accurate fatigue identification and measurement are essential. This was the first study to evaluate the psychometric quality of the Korean version of the FACIT-Fatigue instrument. This study showed the Korean version of the FACIT-Fatigue instrument to be highly reliable and valid for measuring fatigue in Korean patients and also verified the instrument as unidimensional. Therefore, the total score rather than the subscale scores should be used in practice. This study also determined the scale’s cutoff point, which may be used for screening subjects with severe fatigue in both clinical and research contexts.

Although the FACIT-Fatigue instrument is widely used internationally, its dimensionality status remains unclear. The finding in this study regarding scale dimensionality may be applied directly to the other language versions as a guide to selecting scale scores, and it may also indirectly guide the evaluation of the construct validity of the multiple language versions of the FACIT-Fatigue instrument. The cutoff point used in this study may also be referenced and used in other language versions of the instrument, as limited information is currently available regarding the cutoff values appropriate to determining a meaningful level of fatigue.

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**Author Contributions**

Study conception and design: WGL, HJK
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Data analysis and interpretation: WGL
Drafting of the article: WGL
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