Development and validation of the Total Dyspnea Scale for Cancer Patients

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ABSTRACT

Purpose: This study developed a comprehensive measurement tool for assessing dyspnea in cancer patients and examined its reliability and validity.
Methods: This cross-sectional study included 239 cancer patients with awareness of cancer-related dyspnea from outpatient/inpatient wards of six general hospitals in Japan. Items for the Total Dyspnea Scale for Cancer Patients (TDSC) were developed based on qualitative research and a literature review on patients with dyspnea. Ten cancer experts confirmed the scale's content validity. Factor analysis established construct validity. Internal consistency was analyzed by Cronbach's α. Study variables were the effects of dyspnea, worry, and quality of life.
Results: Factor analysis identified 2 factors (11 items): effects on "daily living activities and psychology" and on "social life." Cronbach's α of the whole scale was 0.952 ($p < 0.01$), confirming high reliability. The scale showed high correlation with existing measures. TDSC can comprehensively and multidimensionally evaluate cancer-related dyspnea.
Conclusions: The TDSC consists of 11 items within two factors. Cronbach's α coefficient of the scale was 0.952 in this study, and thus, an acceptable level of reliability was confirmed. In addition, reference-related validity and discriminant validity were verified and confirmed. In future clinical practice, this scale can be utilized as a useful tool for comprehensively and multidimensionally evaluating cancer-related dyspnea.

1. Introduction

Dyspnea is a common symptom in cancer patients. The frequency of occurrence of respiratory distress symptoms in cancer patients varies from 29% to 74% (Ahmedzai, 1998) according to the literature, but it is particularly frequent in the advanced and terminal stages of cancer. Furthermore, due to worldwide population growth and population aging, it is expected that the number of cancer patients will increase to 22 million in 2032, 1.5 times more than in 2012 (World Health Organization, 2014). Therefore, the improvement of support services for cancer patients and survivors worldwide is necessary, and it is also essential to develop nursing care to manage symptoms such as dyspnea.

Dyspnea is related to not only physical deterioration but also anxiety and depression (Tanaka et al., 2002). Onset due to psychological effects such as anxiety is particularly specific to cancer patients and must be emphasized. A previous study revealed that the experience of dyspnea in patients during treatment of lung cancer is influenced by various aspects: physical, psychological, social, and existential (Hashimoto and Kanda, 2011). This suggests that comprehensive support from the perspective of "total dyspnea" is essential to deal with this symptom. However, treatment and care for patients with dyspnea has

not yet been established and remains in development. Systemic administration of morphine is noted as effective in alleviating dyspnea in the Guidelines for Relieving Respiratory Symptoms in Cancer Patients (Ben-Aharon et al., 2012). It is recommended that its usage be started soon after the onset of symptoms and be increased according to the condition (Japan Medical Association, 2008), but the present reality is that morphine use for dyspnea is not sufficiently widespread in the palliative care setting (Ochi et al., 2013).

Meanwhile, as alternatives to pharmacotherapy, ventilation (Wong et al., 2017), and relaxation (Corner et al., 1996) in recent years have been found to relieve dyspnea and contribute to maintenance or improvement in quality of life (QOL). These methods are expected to become more widespread and popularized in the future, but they have not yet fully infiltrated the clinical setting. It is thus difficult to alleviate cancer-related dyspnea, and in the terminal stage, there is no other choice but to begin morphine administration to relieve the pain. This situation reduces cancer patients' QOL and is an urgent global problem that must be solved. It is necessary to develop an assessment tool that is quick and does not distress patients in order to identify care needs that are not evident on the surface.

Several scales assessing cancer-related dyspnea already exist: the

Cancer Dyspnea Scale (CDS) (Tanaka et al., 2000), the Support Team Assessment Schedule (STAS) (Carson et al., 2000), the M. D. Anderson Symptom Inventory (MDASI) (Cleeland et al., 2000), and the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ) (Kobayashi et al., 1998). Additionally, although there is a scale developed for COPD patients, the Short Form Chronic Respiratory Questionnaire (SF-CRQ; Charalambous & Molassiotis, 2017), its reliability and validity for lung cancer patients has been verified through randomized controlled trial. There is a scale that can be verified and considered for use.

The CDS was developed specifically for cancer patients. Its reliability and validity have been confirmed in Japan; however, it requires complicated calculations to obtain scores. Further, it can only assess the nature of dyspnea, and its practical use is limited to indicating the necessity of treatment (Okuyama et al., 2001, 2003), making it difficult to use in clinical practice. The STAS can evaluate the extent to which symptoms influence daily activities. However, it is only a proxy assessment tool completed by medical staff and does not necessarily reflect the patient's subjective opinions. The MDASI and EORTC QLQ include items assessing the extent of the influence of dyspnea on factors such as daily activities and physical aspects and can be used to evaluate the impact on QOL. However, they include many items and can cause significant stress in patients. Further, these scales determine the influence of several symptoms in addition to dyspnea. Therefore, they are limited in terms of obtaining information on dyspnea from a comprehensive perspective. In addition, although SF-CRQ can be used for cancer patients, it has many items and takes time to complete, and so is difficult to use for subjects with impending respiratory distress symptoms. Further, it includes numerous items and takes time to complete making it difficult to use with subjects experiencing urgent dyspnea symptoms. Currently, to measure total dyspnea, the only option is to examine it from various dimensions by integrating multiple scales. A suitable scale that considers patients' stress is non-existent. As such, there is a pressing need to develop an assessment tool that can comprehensively evaluate dyspnea from various perspectives in a simpler way.

The development of a simple assessment tool that decreases the interaction time between medical personnel and patients will be beneficial for medical personnel as it can enable effective intervention. If details of the patient's distress can be understood immediately, a concrete course of action can be specified, promptly leading to the provision of specific care. Therefore, this study developed a scale to comprehensively measure dyspnea in cancer patients and examined the scale's reliability and validity. This scale, which encompasses multiple dimensions, is highly user-friendly and could be used in other countries to deal with cancer-related dyspnea.

2. Purpose

This study developed a comprehensive assessment scale for measuring cancer-related dyspnea and investigated its reliability and validity.

3. Method

3.1. Design

This study used a cross-sectional design to achieve its objectives.

3.2. Conceptual model

The present researchers created a developmental model for the Total Dyspnea Scale for Cancer Patients (TDSC) based on the Revised Model for Symptom Management (Revised MSM) by Dodd et al. (2001), which was created by revising the model for symptom management developed by Larson et al. (1994) (Fig. 1). This study theoretically

established that the effects of cancer-related dyspnea can be organized into three types: physical, social, and emotional/spiritual effects. The CDS was also used to measure dyspnea. Further, breathing difficulties are a serious concern. Therefore, the Brief Cancer-Related Worry Inventory (BCWI) was used to measure cancer-related worry. In addition, the experience of breathing difficulty affects cancer patients' QOL. QOL was measured using the Functional Assessment of Cancer Therapy-General (FACT-G) (Vol. 4).

3.3. Process of developing the original measurement scale

The first step was to extract concepts and to create questionnaire items. In order to clarify the concept of cancer-related dyspnea, concept analysis was performed using Walker and Avant's concept analysis method (Heyse-Moor et al., 2000; van der Molen, 1995). The results of the concept analysis (Hashimoto et al., 2017) clarifying the attributes of dyspnea in cancer patients showed that it influences several factors: daily living activities, physical aspects, psychological aspects, social aspects, and spirituality. These formed one element of the scale. In addition, an existing scale related to the feeling of breathing was added. The contents of these item pools were organized, and a draft questionnaire of 73 items was created.

Second, content validity was examined with the help of cancer experts. A questionnaire survey was administered to ten experts, including specialized oncology nurses, cancer nursing researchers, and cancer specialists. Based on the questionnaire responses, the coincidence ratio of all items was calculated, and items with less than 70% coincidence were deleted. The remaining 47 items were included in a draft of the scale.

Third, a provisional scale was developed by modifying the draft based on a pretest. From May to June 2017, a pretest was conducted using the original scale. The subjects were 10 males and females with lung, mammary gland, and prostate cancer. Based on their opinions, items with similar content were integrated or expressions were modified to develop a provisional scale of 45 items.

3.4. Present survey

3.4.1. Participants and setting

The subjects were cancer patients with awareness of dyspnea related to cancer. The sample size was determined to be 225 using the power analysis software G-power (Ver. 3.1). The investigation period was from June 2017 to June 2018. The survey was conducted at outpatient and inpatient wards of six general hospitals in Japan.

3.4.2. Methodologic approach and variables

Questionnaires were distributed to the subjects who agreed to participate in the study. They were asked to return the completed questionnaire by mail or to place it in a collection box. In addition, basic information about the subjects was collected by viewing the electronic medical chart.

The questionnaire survey included the following: the newly developed scale (TDSC); existing scales (CDS [Tanaka et al., 2000], BCWI [Hirai et al., 2008], FACT-G Version 4 [Cella et al., 1993]); and supplemental questions about attributes. CDS is a dyspnea measure developed for cancer patients. It is a five-point Likert scale consisting of 12 items in 3 factors: sense of respiratory effort (5 items); sense of breathing discomfort (3 items); and sense of respiratory anxiety (4 items). The higher the score, the stronger the breathing difficulty (Cronbach's α: 0.64). BCWI is a psychological measure to evaluate cancer-related worry among cancer patients. It consists of 15 items in 3 factors: future prospects (6 items); physical and symptomatic problems (4 items); and social and interpersonal problems (5 items). The higher the score, the greater the worry (Cronbach's α: 0.87). FACT-G was developed to measure cancer-specific health-related QOL. It is a four-level Likert scale consisting of 27 items in 4 factors: physical well-being (7
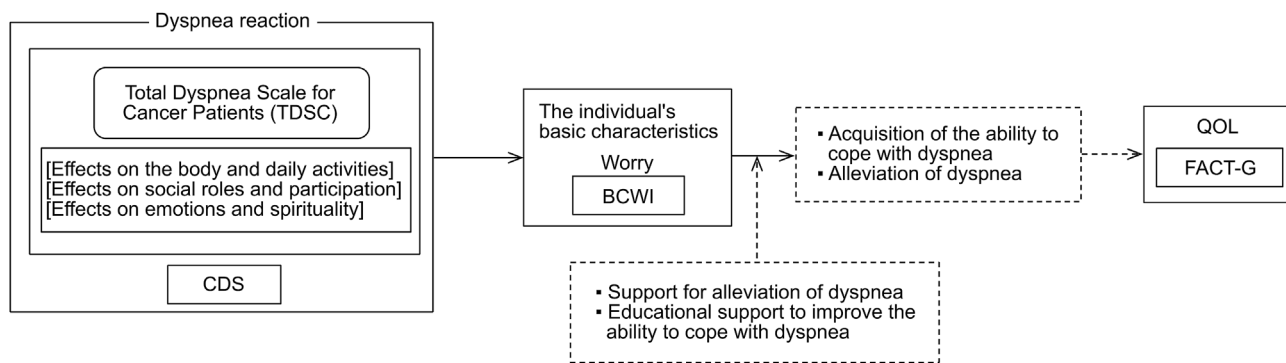
Note. Solid lines indicate contents measured in this study. Dotted lines indicate hypothetical contents.

Fig. 1. Developmental model for the Total Dyspnea Scale for Cancer Patients.

items); functional well-being (7 items); psychological well-being (6 items); and social/family well-being (7 items). The higher the score, the higher the QOL (Cronbach's α: 0.89).

The main study variables were the effects of dyspnea, pain of dyspnea, concern, and quality of life.

3.5. Analysis method

Statistical analyses were conducted using IBM SPSS Statistics Version 25.0, and the following procedures were carried out. After determining the items to be deleted due to ceiling/floor effects or inter-item correlation analysis, item-total correlation (I-T correlation) was performed with the revised items. Regarding construct validity, an exploratory factor analysis was performed based on the principal factor method using ProMax rotation with the items remaining after item analysis. Items with low communality or low factor loading were removed. Each factor was named based on its interpretation. Subsequently, a model was constructed for confirmatory factor analysis, and the goodness of fit was confirmed through covariance structure analysis. The following goodness of fit indices were employed: GFI (goodness of fit index), AGFI (adjusted goodness of fit index), CFI (comparative fit index), and RMSEA (root mean square error of approximation). Internal consistency was confirmed through calculations of Cronbach's α coefficients for the whole scale and for each factor. Further, regarding stability, confidence coefficients were calculated and investigated according to the split-half method using the Spearman-Brown formula. Regarding criterion-related validity, correlation coefficients were calculated and investigated with the CDS, FACT-G, and BCWI as external criteria. Further, for discriminant validity, for the CDS and BCWI, the top 10% in total scores were classified as a high-score group, while the bottom 10% were classified as a low-score group, and the discriminatory power with the total scale score was evaluated by a *t*-test.

3.6. Ethical considerations

This study was approved by the ethical review board for medical research of Gunma University and the institutional review board of each institution (2016-097). Information regarding the purpose and content of the study, study methods, voluntary participation, right to withdraw, protection of personal information, guarantee of anonymity, data storage and deletion methods, and publication of research results was provided to all subjects orally and through a written document. They were told that they would suffer no disadvantage in treatment or care for refusing to participate. Consent for participation was obtained by signing an informed consent form. Existing scales were used after obtaining permission from the original creators.

4. Results

Of the 278 individuals who agreed to participate, responses were received from 260 individuals (response rate: 93.5%). Of these, 21 were judged as invalid responses and excluded owing to incomplete data; for example, missing responses to questions in the newly developed scale or the existing scales or failing to answer at least 90% of other questions such as subject characteristics. There were ultimately 239 valid responses which were used for analysis (valid response rate 91.9%).

4.1. Subjects' characteristics

There were 135 males (56.5%) and 104 females (43.5%), with an average age of 67.42 (± 11.33) years (see Table 1). The most common cancer site was the gastrointestinal system (38.1%), followed by the lungs (32.2%). Cancer in these two organ systems comprised over two-thirds of all cases. Regarding cancer stage, 72.0% of the patients had

Table 1
Subjects' characteristics (N = 239).

Characteristics		n	%
Gender	Male	135	56.5
	Female	104	43.5
Age	Mean (± SD)	67.42	
		(± 11.33)	
	Median Range	6924–91	
Performance Statistics	0	36	15.1
	1	61	25.5
	2	137	57.3
	3	5	2.1
Cancer Site	Gastrointestinal system	91	38.1
	Lungs	77	32.2
	Breasts	17	7.1
	Blood/hematopoietic	16	6.7
	Urinary system	9	3.8
	Uterus/ovaries/vagina	9	3.8
	Otolaryngeal/pharyngeal/neck	4	1.7
	Prostate gland	3	1.3
	Other	13	5.4
Stage	Stage I	5	2.1
	Stage II	14	5.9
	Stage III	31	13.0
	Stage IV	172	72.0
	Unknown	17	7.1
Treatment Environment	Inpatient	118	49.4
	Outpatient	121	50.6
Inhaled Oxygen Therapy	Yes	95	39.7
	No	144	60.3
Resting SpO2	≥95%	217	90.8
	90%–95%	21	8.8
	≤90%	1	0.4

Table 2
Results of the factor analysis and item analysis for the Total Dyspnea Scale for Cancer Patients (N = 239).

	Factor		Item-total correlation co-efficient
	1	2	
Factor 1: Effects on daily living activities and psychology (α = 0.947)			
16: Labored breathing makes it difficult to have a conversation	**0.891**	−0.011	0.865
2: Labored breathing makes it difficult to swallow food and drink	**0.876**	−0.006	0.857
3: Due to labored breathing, I cannot bear down when having a bowel movement	**0.818**	0.033	0.887
17: Labored breathing makes it difficult to sleep	**0.796**	0.115	0.840
1: I cannot breathe easily	**0.723**	0.104	0.818
34: Due to labored breathing, I do not have motivation to do anything	**0.642**	0.245	0.863
29: I always worry when it will become difficult to breathe	**0.478**	0.393	0.844
Factor 2: Effects on social activities (α = 0.859)			
24: Due to labored breathing, I cannot participate in community gatherings or activities	−0.038	**0.896**	0.795
21: Due to labored breathing, I cannot do my job as I would like to	0.008	**0.732**	0.713
25: Due to labored breathing, it is stressful to interact with those around me	0.294	**0.590**	0.839
12: Due to labored breathing, I cannot go up or down stairs	0.247	**0.484**	0.723
Inter-factor correlation (Factor 1)	1.000		
(Factor 2)	0.797		1.000

The level for retaining an item was set at a factor loading higher than 0.4 (principal factor method with promax rotation), indicated in **bold.**

Stage IV terminal cancer.

4.2. Item analysis

Of the 45 items, one item demonstrated a ceiling effect, and no items demonstrated a floor effect. Pearson's product-moment correlation coefficients were calculated, and items demonstrating a strong inter-item correlation ($r > 0.70$) were identified and investigated as potential items to be deleted. When a strong correlation was observed between several items, easier expressions or content specialized for symptoms of dyspnea were prioritized, resulting in the removal of 30 items. There were no items demonstrating a weak correlation ($r < 0.30$) to total score in I-T correlation analysis.

4.3. Exploratory factor analysis and factor naming

When factor analysis was performed with the 15 remaining items, the Kaiser-Meyer-Olkin sampling adequacy value was 0.946, confirming satisfactory validity (see Table 2). The p-value for Bartlett's test of sphericity was 0.000, confirming inter-question correlation, and it was determined that common factors should be investigated.

Next, when the exploratory factor analysis was performed through the principal factor method with ProMax rotation, there was a large slope of two to three in the scree plot, and the eigenvalue became greater than one with two factors. The contribution rate of each factor was in the range of 0.79%–7.32%, and the cumulative contribution ratio was 64.1%. When factor analysis was repeated following the standard of removing items with a factor loading of less than 0.4 and those with a loading roughly equal to another factor, four items were removed, and an eleven-item two-factor structure was adopted. This was finally established as the TDSC.

The interpretation of each factor is as follows. Factor 1 was interpreted as items denoting difficulties or obstacles to daily living activities, such as eating, toileting, sleeping, and having conversations, occurring due to dyspnea, as well as items denoting psychological problems accompanying dyspnea in the form of worry, motivation, and ease of breathing. This factor was named "effects on daily living activities and psychology." Factor 2 was interpreted as items denoting effects on social roles in terms of one's job or activities in the community, as well as effects on participation in social activities of daily living in the form of stress due to interacting with others—a necessary step in engaging in social activities—and going up and down stairs—one daily living activity necessary when going outdoors. This factor was named "effects on social activities."

4.4. Confirmatory factor analysis

To confirm the factor structure, a confirmatory factor analysis was performed using the covariance structure analysis software IBM SPSS Amos Version 25.0. The two factors and eleven items obtained from the exploratory factor analysis were used provisionally to create a hypothesis model assuming the covariance between factors. The goodness of fit indices did not meet the standard with values of GFI = 0.876, AGFI = 0.842, CFI = 0.936, and RMSEA = 0.108, but path coefficients were all above 0.4 ($p < 0.01$), confirming an index that met acceptable standards. However, because most subjects in the present survey had been objectively judged to have dyspnea, the study sample was biased in that there were more moderate cases than mild cases. This is assumed to be the reason the model's goodness of fit did not meet the standard.

4.5. Examination of reliability

Cronbach's α coefficient for the whole scale was 0.952. Cronbach's α for the factors was 0.947 for "effects on daily living activities and psychology" and 0.859 for "effects on social activities." As these exceeded the standard of 0.80 or above, internal consistency for the whole scale and for each factor was confirmed. When a confidence coefficient was calculated using the Spearman-Brown formula according to the split-half method, in which the finalized factors and items from factor 1 were arranged in order, numbered, and divided into even-numbered and odd-numbered question groups, the confidence coefficient was 0.909 ($p < 0.01$), confirming the scale's stability.

4.6. Examination of validity

4.6.1. Criterion-related validity

To investigate the relationship between the scale and external criteria, correlations with the CDS, BCWI, and FACT-G were computed (see Table 3). For the relationship with the CDS, a strong correlation was confirmed for the total score ($r = 0.760$, $p < 0.01$) and for factor 1 "effects on daily living activities and psychology" ($r = 0.779$). For the relationship with the BCWI, a moderate correlation was confirmed for the total score ($r = 0.678$, $p < 0.01$) and for factor 1 "effects on daily living activities and psychology" ($r = 0.701$, $p < 0.01$). For the

Table 3
Correlations between the TDSC and the CDS, FACT-G, and BCWI (N = 239).

	CDS Total		BCWI Total		FACT-G Total	
	Correlation Coefficient	p	Correlation Coefficient	p	Correlation Coefficient	P
TDSC Total	0.760**	0.000	0.678**	0.000	0.436**	0.000
Effects on daily living activities and psychology	0.779**	0.000	0.701**	0.000	0.399**	0.000
Effects on social activities	0.664**	0.000	0.563**	0.000	0.436**	0.000

Pearson correlation coefficient **p < 0.01.

relationship with the FACT-G, a moderate correlation was confirmed for the total TDSC score (r = 0.436, p < 0.01). The above relationships with the CDS, BCWI, and FACT-G confirmed criterion-related validity.

4.6.2. Discriminant validity

For the total scores of the CDS and BCWI, a high-score group (n = 24) and a low-score group (n = 24) were created from the top 10% and bottom 10%, respectively, and a *t*-test was used to examine significant differences in the total scale score and sub-scale average score. As a result, for all scales, the high-score and low-score groups both demonstrated a p-value of 0.000, and a significant difference in average score was confirmed (p < 0.05). This confirmed discriminant validity between the TDSC and the BCWI.

5. Discussion

5.1. Characteristics of Total Dyspnea Scale for Cancer Patients

This study developed a reliable and valid scale that can, for the first time, comprehensively evaluate breathing difficulty in cancer patients worldwide. The TDSC has three features. First, it can comprehensively assess dyspnea. The CDS, an existing scale, can only measure three types of discomfort: respiratory effort, respiratory discomfort, and respiratory anxiety. The TDSC includes items related to behaviors easily affected by dyspnea, including eating, toileting, and engaging in conversations, as well as items related to social activities that are valued by cancer patients. Thus, through this scale, it is possible to assess the effects of dyspnea in a multidimensional manner.

Second, the TDSC measures the feeling of dyspnea in cancer patients. This scale is based on patients' subjective evaluations, and its foundation lies in qualitative research with cancer patients and concept analysis. The item "I always worry when it will become difficult to breathe" was derived from the experience of dyspnea in cancer patients. This shows that dyspnea is an experience accompanied by even greater anxiety and fear, as it involves experiencing the fear of death because of being unable to breathe as well as due to the worsening of cancer (Hashimoto and Kanda, 2011). Because cancer patients are constantly thinking about questions such as "Did my cancer become worse because my symptoms have become worse?" and "Is death imminent?" (Hashimoto and Kanda, 2011), they are always worried about when it will become difficult to breathe again. The fact that it includes such items, which are characteristic of and important to cancer patients, is an important feature of the TDSC. Further, although in theory the factor structure was established according to three types of effects—physical, social, and emotional/spiritual—the results of the factor analysis integrated these types into the two factors of "effects on daily living activities and psychology" and "effects on social activities." Through the analysis process, the dimension of physical and daily living activities and the psychological dimension, denoting emotions, were integrated into one factor. This is because it is difficult to clearly separate the physical and psychological dimensions, as dyspnea is perceived as not only a physical sensation but also a psychological sensation. Further, as Cronbach's α was similar for factors 1 (0.947) and 2 (0.859), both are considered indispensable to patients. It was revealed that maintaining both fundamental daily living activities and social activities is an

extremely important factor in maintaining QOL in cancer patients suffering from dyspnea. Furthermore, the stairs rise and fall included in the second factor is an item that can be positioned in activities of daily living (ADL), which is the movement around the house at Barthel index (Mahoney & Barthel, 1965)); however, in this study, the stairs rise and fall is not was positioned as affecting social life. This is considered to be because the stairs that the subjects imagined were not the ones in the house but the ones outside. In the outdoor environment on the go, there are situations where you have to use the stairs, and because it is difficult to distribute the pace according to the symptoms due to the concern for not giving trouble to the surroundings, it was interpreted by imaging the stairs up and down outdoors. Interpretation of patients' subjective thoughts and understanding was prioritized, and stair climbing was positioned as the second factor. From this point as well, it is emphasized that this scale reflects the patients' subjectivity.

Third, the TDSC excels in its simplicity. This scale has 11 items, which is fewer than the CDS, and it can evaluate dyspnea from a comprehensive perspective. Moreover, inverted items are not included; this helps to maintain the simplicity of scoring. Furthermore, the items of this scale are directly linked to the perspective of nursing intervention by nurses. This measure consists of two subscales, which can clarify the specific effects of dyspnea. Therefore, it makes it easy to provide directions for support, and it is also easy to evaluate. Because of this, high utility can be expected in clinical practice.

5.2. Reliability and validity of the Total Dyspnea Scale for Cancer Patients

The scale's reliability has been established. Cronbach's α coefficient was 0.952, and the confidence coefficient from the split-half method using the Spearman-Brown formula was 0.909, indicating acceptable levels of internal consistency and stability. Further, regarding theory construction for the TDSC, this was completed and the conceptual model was created based on qualitative research with cancer patients suffering from dyspnea (Hashimoto and Kanda, 2011) and concept analysis using existing scales (Hashimoto et al., 2017), as well as multiple other materials including previous research, related literature, and the Revised MSM (Dodd et al., 2001). In the drafting stage, the scale was determined to have consistency considering the response concordance rate and the opinions of cancer experts regarding the factors and questionnaire items. The internal consistency of the TDSC was further verified because theory construction followed the above process.

Regarding validity, the factor structure of the TDSC was found to be valid based on Cronbach's α coefficient for each factor as well as the factor loading of each item. However, as most subjects in the present survey had been objectively judged to have dyspnea, the study sample was biased in that there were more moderate cases than mild ones. This is assumed to be the reason the model's goodness of fit did not meet the standard. Accordingly, in the future, it will be necessary to confirm the model's goodness of fit using a sample with a greater number of mild cases and to re-examine the construct validity.

Regarding the exploration of criterion-related validity, significant positive correlations were observed between the TDSC, CDS, and BCWI. As a strong correlation was seen in the TDSC's relationship with the CDS, an existing scale, it is thought that the TDSC can successfully

measure the same concept as an exterior criterion reflecting the concept of cancer-related dyspnea. Additionally, in the relationship with the external criterion of the BCWI, as a strong correlation was confirmed particularly for factor 1 "effects on daily living activities and psychology," a correlation with worry was confirmed. In other words, individuals who score high for dyspnea as measured by the TDSC also score high for worry. A correlation was confirmed with the TDSC because worry is a short-term response assessed simultaneously with dyspnea. Meanwhile, in the relationship with FACT-G, moderate correlations were confirmed for the total score and factor 2. The reason a strong correlation was not seen between the TDSC and QOL is probably because QOL is a concept that cannot be recognized or assessed if there is not some degree of long-term time lapse, and therefore, it is not assessed simultaneously with dyspnea. Additionally, the results of a comparison of the TDSC total score by a high group and a low group with the BCWI total score demonstrated that the average BCWI score was significantly higher in the high group than the low group, confirming discriminant validity between the TDSC and BCWI.

5.3. Implications for nursing

The TDSC can be expected to be used as a clinical tool that can comprehensively evaluate cancer-related dyspnea from a multidimensional perspective. In addition, the use of the TDSC supports a simple self-assessment of dyspnea, so that information is effectively provided to medical personnel. It can also be used for outcome assessment in intervention studies aimed at alleviating dyspnea. The TDSC may also help evaluate the effectiveness of education to ease the symptoms of dyspnea in cancer patients and assist them with coping with the symptoms.

5.4. Limitations

Owing to the fact that the research subjects consisted of patients with cancer, study subjects were primarily individuals with moderate dyspnea, and the sample included only a small number of mild cases, there is bias in the data. Therefore, it would be desirable to reverify the scale's reliability and validity using a sample with an increased number of mild cases.

6. Conclusion

The TDSC consists of 11 items in 2 factors. Cronbach's α coefficient of the scale was 0.952 in this study, and thus, an acceptable level of reliability was confirmed. In addition, reference-related validity and discriminant validity were verified and confirmed. In future clinical practice, this scale can be utilized as a useful tool for comprehensively and multidimensionally evaluating cancer-related dyspnea.

Conflicts of interest

The author declares no potential conflicts of interest with respect to the research, authorship, and/or publication of this work.

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