Brief Methodological Report

Assessment of the Psychometric Properties of an English Version of the Cancer Dyspnea Scale in People With Advanced Lung Cancer

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Abstract

Context. Dyspnea is a poorly understood subjective sensation. Existing dyspnea measures fail to adequately address its multidimensionality. A Japanese group developed and validated the Cancer Dyspnea Scale (CDS) for assessing dyspnea in patients with advanced lung cancer.

Objectives. We evaluated the validity and reliability of the English version of the CDS (CDS-E) that has 12 items and takes, on average, 140 seconds for individuals to complete.

Methods. Eligible patients had advanced lung cancer, consented, and were fluent in English. Participants completed a 100 mm visual analogue scale (VAS), the modified Borg scale, the CDS-E, the Hospital Anxiety and Depression Scale, and the Functional Assessment of Cancer Therapy—Lung quality-of-life scale. Demographic, radiographic, and treatment information were obtained from patients' medical records.

Results. One hundred twelve participants were enrolled at three sites in the U.S., Australia, and the U.K. Mean age was 64.5 years (SD 11.5); 90% were Caucasian, 68% had Eastern Cooperative Oncology Group performance status 0–1, and 50% had non-small cell carcinoma. All completed the CDS-E independently, without difficulty. The CDS-E had reasonable internal consistency overall (Cronbach's $\alpha = 0.71$) and for each of the three factors (effort, anxiety, discomfort Cronbach's $\alpha = 0.80–0.84$). CDS-E scores were significantly correlated with the 100 mm VAS

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($r = 0.82$; $P < 0.001$) and the modified Borg ($r = 0.87$; $P < 0.001$). After factor analysis, the CDS-E was revised by removing three items (r-CDS-E).

Conclusion. The CDS-E and r-CDS-E are reliable and valid measures of the sensation and the psychological components of dyspnea, with the shorter version having similar psychometric properties. J Pain Symptom Manage 2012;44:741−749.

Key Words

Dyspnea (MeSH), lung neoplasms (MeSH), reproducibility of results (MeSH), Cancer Dyspnea Scale, symptom measurement

Introduction

Dyspnea has been defined in many ways, including "an uncomfortable sensation of breathing,"[1] and "a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity."[1] Both pathophysiologic mechanisms and psychosocial concerns contribute to the symptom.[2−7] Current tools for assessing dyspnea such as the visual analogue scale (VAS) and the modified Borg scale do not take the complexity or multidimensionality of the symptom into account but measure the intensity of the sensation.[8,9] Other scales measure physical effort evoking dyspnea,[10,11] but are not suitable for use in patients who are already limited by other conditions. For example, the Medical Research Council breathlessness scale and its modified versions are often used but these are not well validated and they do not adequately assess those patients who are breathless at rest.[12] Additionally, there are few tools that attempt to assess breathlessness using "descriptors" used by patients to describe their symptoms.

The Cancer Dyspnea Scale (CDS)[13] was developed as a multidimensional scale suitable for measuring perceived dyspnea in cancer patients. Consisting of three factors (three, four, and five items each; total 12 items), it was validated using consecutive outpatients plus a cross-sectional sample of inpatients ($n = 166$) in one Japanese hospital. Adequate construct validity, intersubscale correlation, convergent validity, internal consistency, and test-retest reliability were demonstrated. A Swedish translation, the CDS-S, has been validated and found to have comparable psychometric properties to the original.[14] The measure has not been validated in English.[13]

The aim of this study was to assess the validity and reliability of the English translation of the CDS, the CDS-E, in people with lung cancer to provide a multifactorial dyspnea assessment tool in English.

Methods

Translation of the CDS to the CDS-E

The CDS was translated into English by the standard "forward-backward" translation method,[15−17] by Tanaka et al.;[13] this translation produced the version of the CDS-E originally described and published in English in 2000. In creating this version, two independent professional translators with English as a native tongue translated the scale into English and a third independent translator resolved discrepancies. Back translation of the reconciled version was performed by a fourth independent professional translator. Finally, three bilingual experts reviewed and approved this version.

Subjects

Study participants were recruited through the Thoracic Oncology Clinic at Duke University Medical Center in the U.S.; the Oncology and Palliative Care Clinics at the Royal Hallamshire Hospital in the U.K.; and the Oncology and Palliative Care Clinics at Flinders Medical Center, and Repatriation General Hospital in Adelaide, Australia (AUS). Eligible patients carried a pathologic diagnosis of advanced lung cancer of any histologic type (including mesothelioma), provided informed consent, could complete questionnaires without assistance, were fluent in English, and were at least 18 years of age. The same protocol was used at all sites.

The study was approved by the Institutional Review Board/Ethics Committee at all sites.

Procedures

After providing sociodemographic information, each participant completed a series of questionnaires and scales relating to dyspnea, functional status, quality of life (QOL), and psychological well-being. All assessments occurred at the time of scheduled appointments and were administered at one time point. Study personnel at each site collected demographic, clinical, and treatment information using a standardized case report form.

Instruments

CDS—English Version. This instrument assesses breathing difficulty in the few days preceding its administration. It consists of 12 questions, scored on five-point Likert scales ranging from "not at all" to "very much." The questions are grouped into three factors—sense of effort, sense of anxiety, and sense of discomfort (Tables 1 and 2). The original CDS used the time period of "a few days" without further definition. To operationalize this, subjects were instructed to consider "a few days" as "within the past seven days."

Modified Borg Scale. The modified Borg scale is a 12-point numerical plus descriptor scale that assesses the severity of breathlessness.[18] Participants were asked to choose a number from the scale that best described their breathlessness experienced in the seven days preceding study enrollment.

Visual Analogue Scale. Dyspnea intensity was also assessed using a 100 mm horizontal VAS anchored on either end by the terms "no breathlessness" and "worst possible breathlessness." Participants placed a mark on the line that corresponded to breathlessness experienced in the seven days preceding study enrollment.

Hospital Anxiety and Distress Scale. The Hospital Anxiety and Distress Scale (HADS) is a validated scale that measures two psychological factors associated with illness.[19] It consists of 14 questions that assess anxiety and depression scored on four-point Likert scales ranging from 0 to 3.

Functional Assessment of Cancer Therapy—Lung. The Functional Assessment of Cancer Therapy—Lung (FACT-L) is a lung cancer-specific QOL questionnaire containing 36 items scored on five-point Likert scales ranging from "not at all" to "very much."[20] It examines four domains (physical, social/family, emotional, and

Table 1
The Original Cancer Dyspnea Scale

We would like to ask you about your breathlessness or difficulty in breathing. Please answer each question by circling only the numbers that best describe the breathing difficulty that you felt *during the past few days*. Base your response on your first impression.

		Not At All	A Little	Somewhat	Considerably	Very Much
1	Can you inhale easily?	1	2	3	4	5
2	Can you exhale easily?	1	2	3	4	5
3	Can you breathe slowly?	1	2	3	4	5
4	Do you feel short of breath?	1	2	3	4	5
5	Do you feel breathing difficulty accompanied by palpitations and sweating?	1	2	3	4	5
6	Do you feel as if you are panting?	1	2	3	4	5
7	Do you feel such breathing difficulty that you do not know what to do about it?	1	2	3	4	5
8	Do you feel your breath is shallow?	1	2	3	4	5
9	Do you feel your breathing may stop?	1	2	3	4	5
10	Do you feel your airway has become narrower?	1	2	3	4	5
11	Do you feel as if you are drowning?	1	2	3	4	5
12	Do you feel as if something is stuck in your airway?	1	2	3	4	5

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Table 2
Calculation Method (Original CDS-E)

1	Add the scores for each factor together Factor 1 = (items 4 + 6 + 8 + 10 + 12) − 5 = sense of effort Factor 2 = (items 5 + 7 + 9 + 11) − 4 = sense of anxiety Factor 3 = 15 − (items 1 + 2 + 3) = sense of discomfort
2	Add the total scores for each factor together = total dyspnea

CDS-E = Cancer Dyspnea Scale—English version.
Subtractions are to make adjustments for 0 as a state of absence of dyspnea.
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functional well-being), and has an additional lung cancer subscale.

Statistical Considerations

Baseline demographics and clinical characteristics for the overall population and by site were summarized by descriptive statistics. Maximum likelihood exploratory factor analysis (EFA) was conducted to confirm that the factors found in the original validation study could be reproduced. Oblique direct quartimin rotation was used.[21] This procedure allows factors to become correlated. Intercorrelations between CDS-E subscales were evaluated by Pearson's correlation coefficients.

After conducting EFA, a reduced version of the CDS-E that dropped three items was proposed. The criterion recommended by Fürntratt ($a2/h2 > 0.5$; those having less than half of their communality on a single factor) identified weak items.[22] This reduced scale is referred to as the r-CDS-E.

Reliability and convergent validity of both the original CDS-E and the r-CDS-E were assessed. Cronbach's alpha coefficients were computed for each component of the CDS-E and the r-CDS-E to verify internal reliability. Convergent validity was measured by Pearson's correlation coefficients; instruments assessed were as follows: VAS, modified BORG, HADS, FACT-L (total score, emotional well-being subscale, and lung cancer-specific subscale only), and physical status (Eastern Cooperative Oncology Group [ECOG] status and oxygen saturation [SpO_2]).

Because the occurrence of selecting double responses to an item was rare, they were included in the analysis as an average of the two responses. The Comprehensive Exploratory Factor Analysis program was used to conduct the factor analysis.[23] SAS version 9.2 (SAS Institute, Inc, Cary, NC) was used for all other analyses. A significance level of 0.05 was accepted for all statistical tests.

Results

Patient Characteristics

A total of 112 patients were enrolled (U.S., $n = 78$; U.K., $n = 12$; AUS, $n = 22$). Three

Table 3
Patient's Characteristics

Characteristics	*n*	%
Total number of patients	109	100
Age at survey completion (years) ($n = 107$)		
<70	71	65
≥70	36	33
Mean (SD)	64.5 (11.5)	
Gender ($n = 108$)		
Male	73	67
Female	35	32
Ethnicity ($n = 108$)		
White	98	90
Black or African American	8	7
Hispanic or Latino	1	1
Ethnicity not otherwise specified	1	1
Marital status ($n = 108$)		
Single	12	11
Married	75	69
Divorced	11	10
Widow/widower	10	9
Histological type ($n = 104$)		
Adenocarcinoma	41	38
Mesothelioma	10	9
Small cell	19	17
Squamous	12	11
Other	22	20
Stage ($n = 104$)		
I	1	1
IIIa	9	8
IIIb	17	16
IV	51	47
Extensive	15	14
Recurrent	11	10
ECOG Performance Status ($n = 102$)		
0	13	12
1	56	51
2	22	20
3	11	10
Days since diagnosis of cancer	107	98
Mean (SD)	316 (410)	
SpO_2 (%)	92	84
Mean (SD)	95.2 (4.7)	

ECOG = Eastern Cooperative Oncology Group; SpO_2 = Saturation of peripheral oxygen.

patients from the U.S. site were excluded from the analysis because of ineligibility after additional pathology review revealed that the patient did not have lung cancer ($n=1$) and failure to respond to all items on the CDS-E ($n=2$). A total of 109 patients were included in the analysis (Table 3). In general, the populations were similar, although the U.S. patients were more likely to be younger (median age 62 vs. 72.5 years for the U.K. and 73 years for AUS) and more likely to be receiving chemotherapy at the time the questionnaires were completed (Table 4).

Exploratory Factor Analysis

The original CDS presented by Tanaka et al.[13] and validated in Swedish[14] was assessed using EFA. A three-factor solution was extracted to test for the three factors identified in the original validation study; this solution resulted in a reasonable fit (RMSEA = 0.07; 90% confidence interval [CI]: 0.02, 0.10). The data also were underfactored and overfactored by extracting two- and four-factor solutions; these solutions resulted in a poorer fit.

The factor loading pattern of our three-factor solution along with those found in the original validation study by Tanaka et al. are presented in Table 5. The discomfort factor corresponded completely with Tanaka et al., whereas the effort and anxiety factors did not. Three of the six items hypothesized to belong to the effort factor did not adequately load on this factor; specifically, item 10 (narrower) had a cross-loading of 0.42 on the effort factor and 0.30 on the discomfort factor; item 6 (panting) had a cross-loading of 0.59 on the effort factor and 0.36 on the anxiety factor; and item 12 (stuck in the airway) appeared to belong to anxiety rather than effort. One of the four items hypothesized to belong to the anxiety factor, item 5 (palpitations and sweating), had an equal cross-loading of 0.38 on the anxiety and effort factors.

Development of the r-CDS-E

Because several of the original CDS-E items loaded on multiple factors or loaded on a different factor than hypothesized, the r-CDS-E was proposed. Two items (5 and 10) were identified by the Fürntratt criterion as having less than half of their communality on a single factor. Item 12 also was considered a weak item as it seemed to belong to another factor. In the r-CDS-E, items 5, 10, and 12 were dropped from the scale. For the r-CDS-E, Factor 1 (effort) comprises items 4, 6, and 8 and Factor 2 (anxiety) comprises items 7, 9, and 11. Because no weak items were identified on Factor 3 (discomfort), the same discomfort items were included in the CDS-E and the r-CDS-E (items 3 and 4).

Descriptive statistics and the intersubscale correlations for the CDS-E and the r-CDS-E are presented in Tables 6 and 7. All pairs of subscales were significantly correlated with one another. Overall, the reduced scale had slightly weaker correlations between subscales compared with the original scale proposed by Tanaka et al.,[13] which may be the result of removal of the items that exhibited loadings on multiple factors.

Reliability

Cronbach's alpha coefficients of the original CDS-E and the r-CDS-E subscales and total

Table 4
Patient Characteristics—Three Populations

	U.S.		U.K.		AUS		Overall	
Characteristics	*n*	%	*n*	%	*n*	%	*n*	%
Total number of patients	75	100	12	100	22	100	109	100
Age at survey completion (years)								
<70	57	76	5	42	9	41	71	65
≥70	18	24	7	58	11	50	36	33
Missing	0	0	0	0	2	9	2	2
Mean (SD)	61.6 (10.6)		72.8 (8.8)		70.5 (11.6)		64.5 (11.5)	
Median (range)	62 (33–81)		72.5 (60–84)		73 (46–88)		64 (33–88)	
Current chemotherapy								
No	42	56	12	100	21	95	75	69
Yes	33	44	0	0	0	0	33	30
Missing	0	0	0	0	1	5	1	1

Table 5
Factor Loading Pattern for Exploratory Factor Analysis ($n = 109$)[a]

Item Number and Content	Factor 1 (Effort)	Factor 2 (Anxiety)	Factor 3 (Discomfort)	Communality
10. Narrower	**0.42 (0.82)**	0.12 (0.16)	0.30 (−0.25)	0.48
12. Stuck in the airway	**0.06 (0.74)**	0.56 (0.31)	−0.17 (0.01)	0.47
4. Short of breath	**0.69 (0.69)**	0.06 (0.16)	−0.15 (−0.27)	0.66
8. Shallow	**0.85 (0.63)**	−0.13 (0.29)	−0.09 (−0.26)	0.70
6. Panting	**0.59 (0.61)**	0.36 (0.35)	0.15 (−0.25)	0.62
7. Breathing difficulty that one does not know what to do	−0.06 (0.11)	**0.94 (0.85)**	−0.07 (−0.19)	0.88
9. Breathing may stop	0.13 (0.25)	**0.54 (0.81)**	−0.09 (−0.15)	0.44
5. Accompanied by palpitations and sweating	0.38 (0.38)	**0.38 (0.67)**	0.08 (0.01)	0.41
11. As if drowning	−0.06 (0.45)	**0.76 (0.65)**	0.02 (−0.08)	0.52
2. Exhale easily	−0.03 (−0.16)	−0.06 (−0.11)	**0.75 (0.94)**	0.63
1. Inhale easily	−0.14 (−0.29)	0.01 (−0.01)	**0.80 (0.91)**	0.74
3. Breathe slowly	0.06 (−0.18)	−0.05 (−0.17)	**0.77 (0.88)**	0.58

[a]The factor loading pattern for the present study is given along with those from the original validation study by Tanaka et al. (provided in parentheses). The numbers in bold are the items that were found by Tanaka et al. to load on the specific factors.

score are shown in Table 8. All Cronbach's alpha coefficients were acceptable ($\alpha \geq 0.70$) except for the total score of the reduced scale ($\alpha = 0.52$). The Cronbach's alpha for the total score of the original CDS-E was 0.71 (95% CI: 0.6332, 0.7707). This tight CI supports the fact that the sample size ($n = 109$) is adequate. The lower Cronbach's alpha for the r-CDS-E suggests that the r-CDS-E subscales should be used rather than a total score for the reduced scale. Overall, the reduced scale did not improve internal reliability over the original scale proposed by Tanaka et al.[13] in our patient population.

Convergent Validity

Correlations between the CDS-E subscales and other relevant measures are shown in Table 9 for the original CDS-E and the r-CDS-E. Both the CDS-E and the r-CDS-E were significantly correlated with the VAS, modified Borg, HADS, FACT-G, FACT-L, and ECOG, as expected. All subscales of the original CDS-E and the r-CDS-E were significantly correlated with SpO_2 except for the anxiety subscale. The strongest correlations were between CDS-E/r-CDS-E subscales and the VAS, modified Borg, and FACT-L measures. The weakest correlations were between CDS-E/r-CDS-E subscales and FACT-G emotional and SpO_2. Overall, the reduced scale had slightly weaker correlations with other relevant measures compared with the original CDS-E subscales proposed by Tanaka et al.[13] This is likely because of the fact that the removed items were contributing to the correlations.

Table 6
Descriptive Data—Tanaka CDS-E and *reduced* CDS-E

	Tanaka CDS-E	*reduced* CDS-E
CDS-E Factors	Mean Score (SD) ($n = 109$)	Mean Score (SD) ($n = 109$)
Factor 1 (effort)	5.0 (4.5)	3.5 (3.1)
Factor 2 (anxiety)	1.6 (2.8)	1.0 (2.1)
Factor 3 (discomfort)	1.9 (2.2)	1.9 (2.2)
Total score	8.4 (8.1)	6.4 (6.1)

CDS-E = Cancer Dyspnea Scale—English version.

Discussion

Dyspnea is a common symptom in terminally ill patients, with prevalence estimates ranging from 29% to 74%;[24] dyspnea increases as death approaches despite palliation.[25] Measurement of dyspnea is particularly difficult in cancer patients because the symptom is multidimensional. The original CDS was developed and validated in a Japanese population in an attempt to assess more than just the physical sensation.[13]

The original CDS has been validated in Japanese and Swedish.[13,14] This present study contributes to the body of literature supporting the CDS, and specifically the English translation, with convergent validity assessments similar to the Japanese and Swedish studies. For example, Tanaka et al. reported convergent validity, with correlations between the CDS and

Table 7
Intersubscale Correlations for the CDS Three-Factor Solution ($n = 109$)

CDS-E Factors	Factor 1	Factor 2	Factor 3	*reduced* CDS-E Factors	*reduced* Factor 1	*reduced* Factor 2	*reduced* Factor 3
Factor 1 (effort)	–	–	–	Factor 1 (effort)	–	–	–
Factor 2 (anxiety)	0.71[a]	–	–	Factor 2 (anxiety)	0.57[a]	–	–
Factor 3 (discomfort)	0.56[a]	0.47[a]	–	Factor 3 (discomfort)	0.55[a]	0.48[a]	
Total score	0.95[a]	0.79[a]	0.75[a]	Total score	0.92[a]	0.70[a]	0.79[a]

CDS = Cancer Dyspnea Scale; CDS-E = Cancer Dyspnea Scale—English version.
[a]Correlation significant at the $P < 0.001$ level (two-tailed).

the VAS and modified Borg scales between 0.40 and 0.77, whereas the Swedish group reported correlations between the CDS-S and the VAS and European Organization for Research and Treatment of Cancer Quality of Life-Core 30 Lung Cancer module dyspnea scale ranging from 0.39 to 0.71.[13,14] Similarly, the strongest correlations in the present study were between the CDS-E and dyspnea intensity measures such as the VAS and Borg scales (ranging from 0.59 to 0.87). There were significant correlations between all factors of the CDS-E and physical function as measured by ECOG performance status (ranging from 0.27 to 0.48) and FACT-L total score (−0.46 to −0.63); the negative correlations between the CDS-E and the FACT-L are consistent with the presumed association between higher level of function and lower burden of dyspnea. There was also significant negative correlation between all three factors and the emotional subscale of the FACT-G, supporting our assertion that the CDS-E captures the psychological component of dyspnea.

In the EFA, there were several items that loaded differently than in the original Tanaka et al. study. This finding also was seen in the Swedish validation, and was presumed cultural, although the discrepancies noted in our study involved different items. Three items (item 10, item 6, and item 12) that originally loaded on the effort factor in the Japanese study exhibited loadings on multiple factors or loaded on a different factor in our English study. One item (item 5) that originally loaded on the anxiety factor also exhibited loadings on multiple factors. To reconcile the differences, we developed a reduced version of the CDS-E (r-CDS-E) by removing items 5, 10, and 12. Although item 6 exhibited loading on multiple factors, it was retained because at least 50% of its variance was accounted for by the effort factor. The reduced scale still comprises three domains (Table 10), with reliable subscales (Cronbach's alpha for total r-CDS-E and the subscales ranging from 0.0.52 to 0.84) and significant intersubscale correlations. Significant correlations were also noted between the r-CDS-E and other relevant measures, although the r-CDS-E anxiety scale also had slightly weaker correlations with other measures, including the VAS, Borg, and HADS. The reduced correlations were small in magnitude and may be because the HADS assesses general anxiety, whereas the CDS captures anxiety specific to dyspnea. Advantages of the r-CDS-E are that it is shorter and presents less patient burden, that questions are streamlined and succinct, that cross-loading items have been removed, and that it is better for assessing the subdomains of dyspnea (Table 11).

Table 8
Reliability of the CDS and the *reduced* CDS

	Tanaka CDS-E	*reduced* CDS-E
CDS Factors	Cronbach's Alpha Coefficient ($n = 109$)	Cronbach's Alpha Coefficient ($n = 109$)
Factor 1 (effort)	0.84	0.82
Factor 2 (anxiety)	0.80	0.79
Factor 3 (discomfort)	0.84	0.84
Total score	0.71	0.52

CDS = Cancer Dyspnea Scale; CDS-E = Cancer Dyspnea Scale—English version.

Our study demonstrates that the CDS-E and the r-CDS-E are both reliable and valid but that they have different properties that make them useful for different purposes in the clinical and the research arenas. The original CDS-E is a better measure of global dyspnea, whereas the r-CDS-E subscales are better suited for measuring the distinct domains of dyspnea (effort, anxiety, and discomfort). Given this observation, we would suggest that the original CDS-E be used for assessments but that the scoring

Table 9
Correlations Between the Tanaka CDS-E and the *reduced* CDS-E and Other Measures

			HADS ($n=87$)			FACT-G ($n=87$)		FACT-L ($n=87$)		Physical Status	
Tanaka CDS-E Factors	VAS ($n=104$)	Modified BORG ($n=105$)	Anxiety	Depression	Total Score	Emotional	Total Score	Lung Cancer Subscale	Total Score	ECOG ($n=102$)	SpO_2 ($n=92$)
Factor 1 (effort)	0.80[a]	0.86[a]	0.50[a]	0.38[a]	0.53[a]	−0.23[c]	−0.56[a]	−0.70[a]	−0.63[a]	0.48[a]	−0.28[b]
Factor 2 (anxiety)	0.59[a]	0.64[a]	0.32[b]	0.44[a]	0.45[a]	−0.23[c]	−0.44[a]	−0.44[a]	−0.46[a]	0.27[b]	−0.14
Factor 3 (discomfort)	0.59[a]	0.64[a]	0.40[a]	0.43[a]	0.50[a]	−0.26[c]	−0.49[a]	−0.54[a]	−0.55[a]	0.32[b]	−0.23[c]
Total score	0.82[a]	0.87[a]	0.49[a]	0.45[a]	0.57[a]	−0.28[b]	−0.58[a]	−0.68[a]	−0.65[a]	0.44[a]	−0.29[b]
reduced CDS-E Factors											
Factor 1 (effort)	0.81[a]	0.85[a]	0.44[a]	0.34[b]	0.47[a]	−0.23[c]	−0.52[a]	−0.63[a]	−0.58[a]	0.45[a]	−0.35[a]
Factor 2 (anxiety)	0.53[a]	0.54[a]	0.27[c]	0.41[a]	0.41[a]	−0.25[c]	−0.38[a]	−0.38[a]	−0.40[a]	0.28[b]	−0.19
Factor 3 (discomfort)	0.59[a]	0.64[a]	0.40[a]	0.43[a]	0.50[a]	−0.26[c]	−0.49[a]	−0.54[a]	−0.55[a]	0.32[b]	−0.23[c]
Total score	0.82[a]	0.86[a]	0.45[a]	0.42[a]	0.53[a]	−0.27[c]	−0.56[a]	−0.63[a]	−0.61[a]	0.42[a]	−0.33[b]

ECOG = Eastern Cooperative Oncology Group; SpO_2 = Saturation of peripheral oxygen.
[a]Correlation significant at the $P<0.001$ level (two tailed).
[b]Correlation significant at the $P<0.01$ level (two tailed).
[c]Correlation significant at the $P<0.05$ level (two tailed).

be varied based on the outcome of interest. For a more general outcome, the total CDS-E score would be used. For a more specific outcome (i.e., one aimed at addressing a certain domain), the reduced CDS-E subscale score would be used. One might use the original CDS-E for measuring dyspnea in the clinic when a more general measure is required, whereas the effects of an intervention designed to relieve dyspnea might be better assessed by using the r-CDS-E subscales. This would allow one to examine which dimension of dyspnea was being affected by the intervention in question. Administering the CDS-E and simply scoring it differently based on the outcome of interest would remove any confusion related to which scale to use in what circumstance and would allow for easier cross-study comparison. Additional studies in larger samples are required to further evaluate this concept.

Potential limitations of the present study are the lack of longitudinal data to demonstrate responsiveness of the CDS-E to change and the minimal time frame in which the change occurs and the lack of assessment of minimally clinically important change in the CDS-E; these are important areas for future study. Strengths of the present study are its multinational sample, which contributes to generalizability of findings; multiple questionnaires assessing construct validity; completeness of data collection; and extensive evaluation of the potential to develop a shorter, less burdensome, more reliable, and valid version of the CDS-E.

Table 10
The *reduced* Cancer Dyspnea Scale (r-CDS-E)

We would like to ask you about your breathlessness or difficulty in breathing. Please answer each question by circling only the numbers that best describe the breathing difficulty that you felt *during the last 7 days*. Base your response on your first impression.

		Not at All	A Little	Somewhat	Considerably	Very Much
1 (1)	Can you inhale easily?	1	2	3	4	5
2 (2)	Can you exhale easily?	1	2	3	4	5
3 (3)	Can you breathe slowly?	1	2	3	4	5
4 (4)	Do you feel short of breath?	1	2	3	4	5
5 (6)	Do you feel as if you are panting?	1	2	3	4	5
6 (7)	Do you feel such breathing difficulty that you do not know what to do about it?	1	2	3	4	5
7 (8)	Do you feel your breath is shallow?	1	2	3	4	5
8 (9)	Do you feel your breathing may stop?	1	2	3	4	5
9 (11)	Do you feel as if you are drowning?	1	2	3	4	5

CDS = Cancer Dyspnea Scale; CDS-E = Cancer Dyspnea Scale—English version.
Items are identified with the number on the r-CDS-E first and the number on the CDS-E in parentheses.

Table 11
Calculation Method (r-CDS-E)

1	Add the scores for each factor together Factor 1 = (items 4 + 5 + 7) − 3 = sense of effort Factor 2 = (items 6 + 8 + 9) − 3 = sense of anxiety Factor 3 = 15 − (items 1 + 2 + 3) = sense of discomfort
2	Add the total scores for each factor together = total dyspnea

r-CDS-E = reduced version of the Cancer Dyspnea Scale—English version.
Subtractions are to make adjustments for 0 as a state of absence of dyspnea.

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