

Reclassification of items in the Leicester Cough Questionnaire: Correlation analysis

Jieun Kang^a, Ji-Yong Moon^b, Deog Kyeom Kim^c, Jin Woo Kim^d, Seung Hun Jang^e, Jae-Woo Kwon^f, Byung-Jae Lee^g, Hyeon-Kyoung Koo^{a,*}

^a Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Ilsan Paik Hospital, Inje University College of Medicine, Juhwa-ro 170, Ilsanseo-gu, Goyang-si, Gyeonggi-do, 10380, Republic of Korea

^b Department of Internal Medicine, Hanyang University Guri Hospital, Hanyang University College of Medicine, Gyeongchun-ro 153, Guri-si, Gyeonggi-do, 11923, Republic of Korea

^c Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Seoul Metropolitan Government-Seoul National University Boramae Medical Center, Seoul National University College of Medicine, Boramae-ro 5-gil 20, Dongjak-gu, Seoul, 07061, Republic of Korea

^d Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Cheonbo-ro 271, Uijeongbu-si, Gyeonggi-do, 11765, Republic of Korea

^e Division of Pulmonary, Allergy, and Critical Care Medicine, Department of Medicine, Hallym University Sacred Heart Hospital, Hallym University College of Medicine, Gwanpyeong-ro 170beon-gil 22, Dongan-gu, Anyang-si, Gyeonggi-do, 14068, Republic of Korea

^f Department of Internal Medicine, Kangwon National University Hospital, Kangwon National University School of Medicine, Kangwondaehak-gil 1, Chuncheon-si, Gangwon-do, 24341, Republic of Korea

^g Division of Allergy, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Irwon-ro 81, Gangnam-gu, Seoul, 06351, Republic of Korea

ARTICLE INFO

Keywords:

Chronic cough
Quality of life
Leicester cough questionnaire
Network analysis
Reclassification

ABSTRACT

Background: The Leicester Cough Questionnaire (LCQ) is a validated tool for assessing cough that has three domains (physical, psychological, and social), with eight, seven, and four items, respectively. However, the assigned domain may not accurately reflect the characteristics of an item. This study aimed to reclassify the items in the Korean version of the LCQ (K-LCQ) to improve the coherence in each domain.

Methods: Data of patients with chronic cough from 16 centers who completed the K-LCQ were retrospectively analyzed. Spearman's rank correlation analysis was used to assess the correlations between items and their domains. Principal component analysis was performed to recategorize the K-LCQ items.

Results: The correlation analysis of the data from 255 patients demonstrated that certain items such as tiredness, embarrassment, and interference with daily work or overall life enjoyment showed strong or very strong correlations with all three domains. Cough bout frequency showed the weakest correlation with the physical domain, despite being included in that domain, and had stronger correlations with the psychological and social domain. The principal component analysis led to the reclassification of six items: one from the physical to psychological, two from the social to psychological, and three from the psychological to social domain. The within-domain correlation coherence was higher in the new classification than in the original. Validation using an independent cohort of 203 patients yielded similar results.

Conclusions: The new classification of the K-LCQ items showed improved within-domain correlation coherence.

1. Introduction

Cough is an important defense mechanism that protects the airways and lungs [1,2]; however, it may become problematic when it persists [3,4]. Several tools are available to evaluate the severity of cough and its impact on health-related quality of life [5–8]. Cough frequency

commonly measured to determine the efficacy of drugs or interventions [9,10]. However, this method has limited application in clinical practice because of the requirement for recording devices and manual counting of cough frequency, which are time-consuming and inconvenient. Patient-reported outcome measurement using validated and reliable questionnaires are more commonly used and regarded as the gold standard for assessment [11].

* Corresponding author.

E-mail address: gusrud9@yahoo.co.kr (H.-K. Koo).

<https://doi.org/10.1016/j.resinv.2024.09.017>

Received 2 May 2024; Received in revised form 11 August 2024; Accepted 29 September 2024

Available online 10 October 2024

2212-5345/© 2024 The Authors. Published by Elsevier B.V. on behalf of The Japanese Respiratory Society. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Abbreviation

LCQ	Leicester Cough Questionnaire
K-LCQ	Korean version of the Leicester Cough Questionnaire
NRS	numeric rating scale

The Leicester Cough Questionnaire (LCQ) was developed to assess the impact of cough on quality of life of patients [6], and the Korean version of the LCQ (K-LCQ) has been validated [12]. The LCQ consists of three domains (physical, psychological, and social) with eight, seven, and four items, respectively [6]. The questionnaire is a patient-reported subjective assessment, which may provide better information on the pathophysiology of cough [13]. The LCQ is a collection of disparate items, and the physical domain includes items such as the presence and severity of phlegm [14,15], hypersensitivity to irritants [16], and sleep disturbance related to nocturnal cough [17]. The psychological and social domains include items that indicate the severity and perception of cough by the patients, such as anxiety [18] and annoyance to others [4]. Understanding the characteristics of each domain and item, as well as their interrelationships, is a potential strategy for understanding cough mechanisms better.

There is a possibility that the traits of a specific item in the LCQ may not be fully encapsulated by the domain it is assigned to. Items such as tiredness or loss of energy are classified as physical components but may also fall into the psychological domain. Concern about the thoughts of others belongs to the psychological domain but can also have a social component. These examples suggest that it is difficult to define the domains of the LCQ items. This study aimed to examine the correlations between the K-LCQ items and domains, reclassify the items to improve coherence in each domain, and further validate the findings using the K-LCQ validation cohort.

2. Patients and methods

2.1. Study patients and data collection

The development cohort included adult patients aged ≥ 18 years diagnosed with chronic cough from 16 respiratory centers in the Republic of Korea between March 2016 and February 2018. Chronic cough was defined as cough lasting for more than 8 weeks [19]. This study used data from patients who completed the K-LCQ at baseline. Patients with chest radiographic abnormalities were excluded. Pulmonary specialists at each hospital evaluated the possible causes of chronic cough based on the Korean cough guidelines [19]. During the initial visit, demographic information, symptom duration, K-LCQ score, symptom severity, and identified causes of cough were collected.

Validation of the reclassified version of the questionnaire was performed using an independent cohort (K-LCQ validation cohort) which was a prospective multicenter cohort study designed to validate the K-LCQ. Adult patients with chronic cough were enrolled between May 2011 and October 2013 [12]. This study was conducted in accordance with the Declaration of Helsinki, and the Institutional Review Board of the participating center approved the study protocol in February 12, 2018 (Approval No. 2017-12-025). The need for informed consent was waived due to the retrospective nature of the study.

2.2. Korean Leicester cough questionnaire

The K-LCQ is a cough-specific quality-of-life questionnaire that has been validated in patients with chronic cough lasting more than 8 weeks [12]. Each of the 19 items in the three domains was rated on a 7-point Likert scale, and the mean scores of each domain were added to obtain the total score [6,12]. The total score ranged from 3 to 21 points,

with higher scores indicating a better quality of life. The physical domain comprised of eight items: chest/stomach pain, presence of bothersome phlegm, tiredness, hypersensitivity to irritants, sleep disturbance, cough bout frequency, voice hoarseness, and loss of energy. The psychological domain consists of seven items: feeling in control of the cough, embarrassment, anxiety, frustration, feeling of being fed-up, worries about serious illness, and concern about the thoughts of other people. The social domain comprised of four items: interference with daily work, interference with overall life enjoyment, interruption of conversation/phone calls, and annoyance with partners/family/friends.

2.3. Statistical analysis

Data were presented as mean \pm standard deviation, or median (interquartile range) for continuous variables and as number (percentage) for categorical variables. A correlation matrix was constructed using Spearman's rank correlation in the corrplot package. The degree of correlation was defined using the Spearman coefficient: >0.7 , very strong; $0.6-0.7$, strong; $0.3-0.6$, moderate; and <0.3 , weak. Each K-LCQ item was represented as a node in the correlation network, and the color reflected the domains to which it belonged: physical, psychological, and social domains as red, green, and blue, respectively. The node size represented the mean score for each item. The links between the nodes demonstrated statistically significant correlations ($p < 0.05$). The thickness and darkness of the links indicated the strength of the correlation (Spearman's coefficient). The igraph package was used to visualize the correlation networks. Principal component analysis, which is a technique for analyzing datasets containing numerous dimensions that can enhance the interpretability of data while preserving maximum information and enabling the visualization of multidimensional data, was performed to transform the K-LCQ item scores into new independent variables (eigenvectors) referred to as components using a combination. The eigenvalue of each component reflected its contribution. Principal component analysis was performed using the prcomp function in the Stats package. All statistical analyses were performed using R software version 3.6.0.

3. Results

3.1. Characteristics of the study patients

A total of 255 patients were included in this study. The baseline characteristics of the patients are shown in [Supplementary Table S1](#). The mean age was 47.7 ± 14.3 years, and 63.1% were women. The most common cause of chronic cough was upper airway cough syndrome (45.5%), followed by asthma (25.9%). More than one etiology of chronic cough was found in 12.5% of the patients. The total mean score of the K-LCQ was 11.2 ± 3.1 , with mean scores of 4.1 ± 0.9 , 3.5 ± 1.2 , and 3.6 ± 1.3 observed in the physical, psychological, and social domains, respectively. The mean score of the cough numeric rating scale (NRS) was 6.0 ± 2.2 .

3.2. Correlation analysis between K-LCQ scores and individual items

[Fig. 1](#) presents the correlation matrix for the K-LCQ items and domains. The total K-LCQ score showed at least moderate correlations with all items. Very strong correlations ($r > 0.7$) were shown with tiredness (LCQ3), embarrassment (LCQ5), anxiety (LCQ6), interference with daily work (LCQ7), interference with overall life enjoyment (LCQ8), frustration (LCQ12), feeling of being fed-up (LCQ13), concern about the thoughts of other people (LCQ17), interruption of conversation/phone calls (LCQ18), and annoyance to acquaintances (LCQ19).

The correlation coefficients of individual items with the subtotal scores for each domain are summarized in [Table 1A](#). The items such as tiredness, embarrassment, interference with daily work, and interference with overall life enjoyment showed strong or very strong

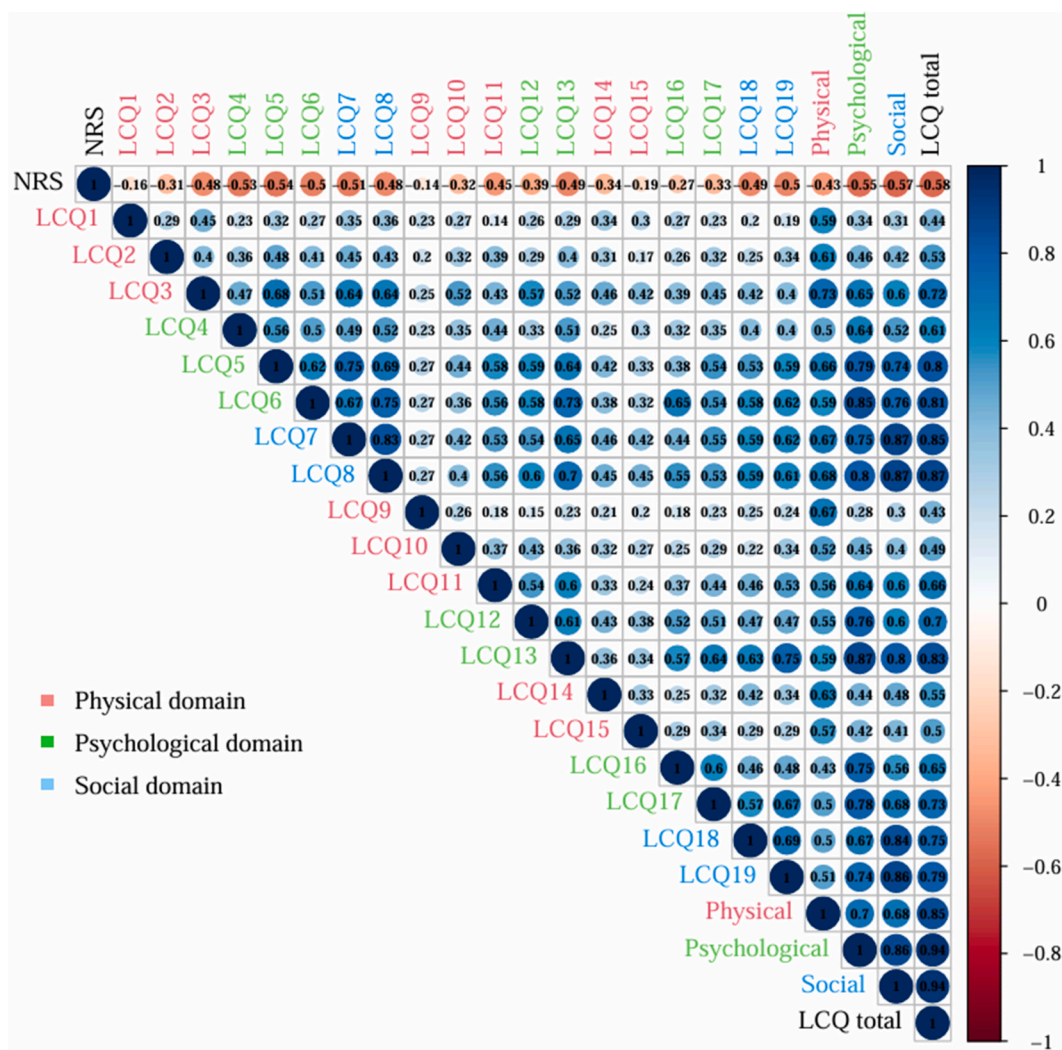


Fig. 1. A correlation matrix between items of cough questionnaire Spearman’s rank correlation analysis was performed between the variables. The number indicates Spearman’s correlation coefficient between items as represented by size and color of circle. Abbreviations: LCQ, Leicester cough questionnaire; NRS, numeric rating scale. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

correlations with all the subtotal scores in all three domains. The correlation coefficients between embarrassment and the subtotal scores of the psychological and social domains were comparable. Despite the inclusion of cough-bout frequency in the physical domain, it exhibited the weakest correlation with the physical domain compared to its correlation with the psychological or social domain. In contrast, hypersensitivity to irritants was strongly correlated with the physical domain but weakly associated with the psychological and social domains. Moderate correlations were observed between chest/stomach pain, sleep disturbance, and energy loss with all three domains. The correlation network between individual items and the original domain classification is shown in Fig. 2A. The correlation matrix between cough NRS and LCQ items is summarized in Fig. 1.

3.3. Principal component analysis

The 19 K-LCQ items were reduced to a small number of components using the principal component analysis. These five components explained 71.7% of the data as measured by the percentage of variance. A scree plot of the eigenvalues for each component is presented in Supplementary Figure S1. The correlations between each K-LCQ item and its five components are presented in Supplementary Table S2.

3.4. New classification of the K-LCQ items

Fig. 3 depicts the classification of items into three groups based on the plot of variance of the principal component analysis. Group 1 comprised exclusively of items from the physical domain; group 2 comprised of items from all three domains (physical, psychological, and social); and group 3 comprised of items from the psychological and social domains.

Based on this grouping, the K-LCQ items were reclassified; groups 1, 2, and 3 were assigned as the new physical, psychological, and social domains, respectively. The correlation network between individual items and the proposed domain classification is shown in Fig. 2B.

The domain changes occurred for certain items: interference with daily work and interference with overall life enjoyment were reclassified from the social to the psychological domain; cough-bout frequency was reclassified from the physical to the psychological domain; and feelings of being fed-up, worries about serious illness, and concerns about the thoughts of other people were reclassified from the psychological to the social domain. In the new classification, cough bout frequency showed a substantially higher correlation with the psychological domain than with the physical domain (new vs. original classification, 0.742 vs. 0.560). The correlation coefficients for other items that underwent a domain change were similar to their original domains. Supplementary

Table 1
Correlation coefficient of each item with corresponding domains in (A) original and (B) new classification.

	(A) Original classification			(B) New classification		
	Physical	Psychological	Social	Physical	Psychological	Social
LCQ 1	0.587	0.343	0.312	0.628	0.345	0.285
LCQ 2	0.607	0.459	0.425	0.622	0.499	0.381
LCQ 3	0.728	0.653	0.604	0.783	0.704	0.525
LCQ 4	0.498	0.639	0.525	0.492	0.677	0.480
LCQ 5	0.663	0.787	0.742	0.659	0.853	0.651
LCQ 6	0.590	0.849	0.759	0.566	0.837	0.754
LCQ 7	0.673	0.747	0.873	0.675	0.860	0.689
LCQ 8	0.676	0.797	0.871	0.670	0.886	0.723
LCQ 9	0.665	0.284	0.298	0.532	0.293	0.272
LCQ 10	0.518	0.453	0.399	0.664	0.497	0.352
LCQ 11	0.560	0.644	0.601	0.471	0.742	0.579
LCQ 12	0.546	0.764	0.601	0.561	0.751	0.623
LCQ 13	0.587	0.868	0.796	0.562	0.795	0.867
LCQ 14	0.628	0.440	0.479	0.653	0.487	0.406
LCQ 15	0.567	0.424	0.415	0.597	0.438	0.374
LCQ 16	0.433	0.754	0.561	0.424	0.581	0.748
LCQ 17	0.505	0.779	0.679	0.487	0.618	0.842
LCQ 18	0.498	0.671	0.839	0.455	0.648	0.809
LCQ 19	0.506	0.736	0.860	0.479	0.686	0.873

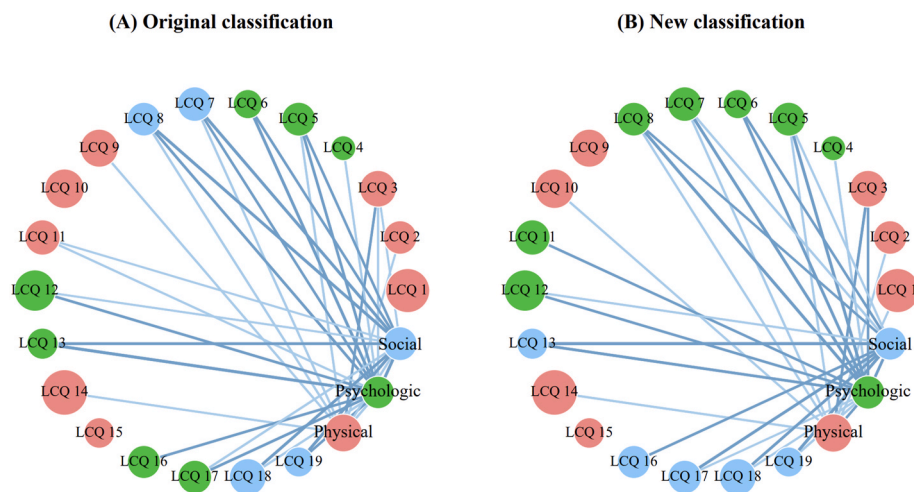


Fig. 2. Network analyses demonstrating associations between K-LCQ items and domain subtotal scores according to the (A) original classification, and (B) new classification. Only correlations with Spearman’s correlation coefficient ≥ 0.6 are drawn. Abbreviations: K-LCQ, Korean version of the Leicester cough questionnaire.

Figure S2 presents a comparison of the subtotal scores of each domain before and after reclassification.

Table 1B shows the correlation coefficients of the individual items with the subtotal score for each domain of the K-LCQ in the new classification. The within-domain correlation coherence was higher in the new classification than in the original. The correlation coefficient plots of the same domain were more parallel in the new classification than in the original, indicating improved within-domain coherence (Fig. 4). Supplementary Figure S3 compares the original and new classifications using a Bland-Altman plot of the correlation coefficient for each item with the corresponding domain score. The mean difference between the original and new correlation coefficients was 0.03.

3.5. Validation of the new classification

Using the same inclusion and exclusion criteria, 203 patients with chronic cough from the K-LCQ validation cohort were included to validate the new classification. The mean age of the validation cohort was 49.3 ± 14.0 years, and 60.6% of the patients were women, which was comparable to the development cohort ($p = 0.227$ and $p = 0.675$, respectively; Supplementary Table S1). Supplementary Table S3 summarizes the comparison of the correlation coefficients of the individual items with the subtotal score of each domain between the original and new K-LCQ classifications. The results showed a similar pattern to the findings in the development cohort, indicating that the new classification maintained good correlation coherence within each domain (Supplementary Figure S4). The mean difference between the original and new correlation coefficients is 0.02 (Supplementary Figure S3B).

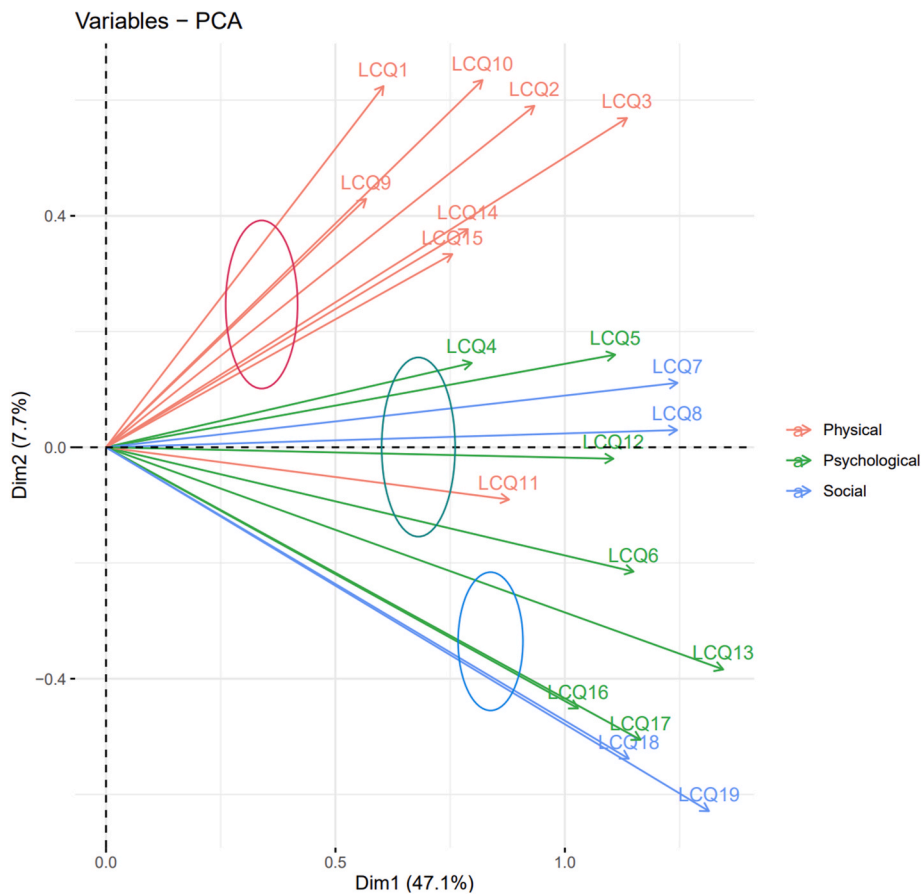


Fig. 3. Principal component analysis. The K-LCQ items were categorized based on a PCA plot of variance. Abbreviations: PCA, principal component analysis; LCQ, Leicester cough questionnaire; dim, dimension.

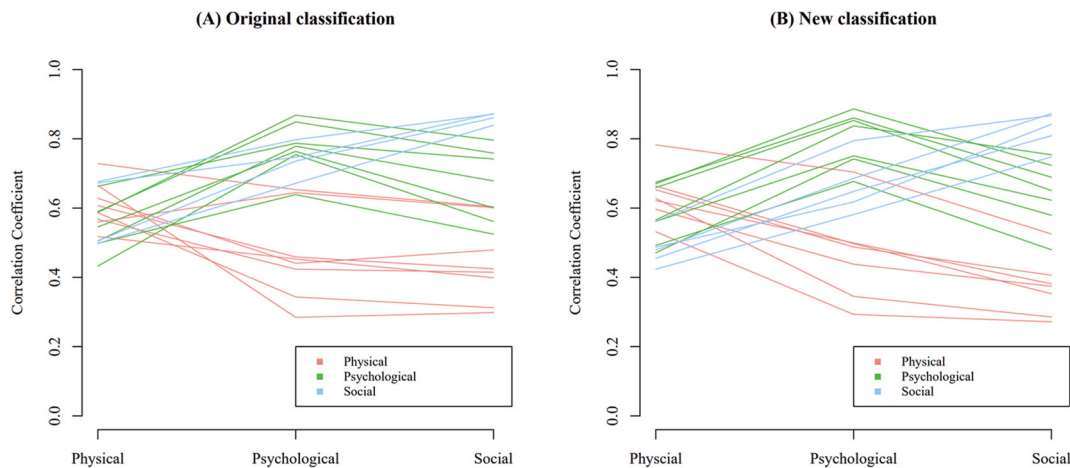


Fig. 4. Coherence of correlation coefficients of K-LCQ items in the corresponding domains according to the (A) original classification and (B) new classification. Abbreviations: K-LCQ, Korean version of the Leicester cough questionnaire.

4. Discussion

This study investigated the complex correlations among the physical, psychological, and social domain items of the K-LCQ using correlation analysis. Based on the correlations of the items in the three domains, the K-LCQ items were reclassified. Six items shifted domains, and the new classification showed higher within-domain correlations between items and their respective domains.

The impact of chronic cough on the quality of life of an individual

can be substantial [20,21], which highlight the need for tools such as the K-LCQ to accurately measure its impact. However, the clinical application of the questionnaire may be challenging if the relationship between its items are not thoroughly understood. Our study sheds light on how the LCQ can be better used to evaluate chronic cough. We found that tiredness, embarrassment, and interference with daily work or overall life enjoyment were equally and strongly associated with the physical, psychological, and social domains. Therefore, these items may serve as indicators of the overall LCQ score.

Stronger correlations were observed between the cough-bout frequency and the psychological and social domains of the LCQ than the original physical domain. We reclassified this item into the psychological domain to reflect its impact on the quality of life of an individual more accurately. Birring et al. reported that cough frequency was significantly correlated with scores in the physical and social domains, but not with scores in the psychological domain [22]. This correlation was stronger in the social domain than in the physical domain; however, this study had a limited sample size of 20 patients with chronic cough. Cough frequency can affect the psychological aspects of coughing by causing emotional distress, anxiety, and social isolation, which can worsen the perception of cough severity [18,23,24]. In a study by Chang et al., the subjective cough score was found to have a stronger and more consistent correlation with cough frequency than with cough hypersensitivity [25], suggesting a close relationship between cough frequency and perception of cough severity.

While cough-bout frequency exhibited a stronger correlation with its newly assigned psychological domain compared to a weaker correlation with its originally assigned physical domain, the correlations for the other items with domain changes were found to be similar in both classifications. This difference may be because cough-bout frequency was the only item originally classified in the physical domain, whereas the other items with domain changes belonged to either the psychological or social domains. Chronic cough is associated with various impairments, including limitations in daily activities, disruption in personal relationships, and emotional distress [26,27]. This underscores the intricate interplay between psychological and social influences in the experience of cough, which may explain the strong correlations that persisted even after the domain change for items that had a change from psychological to social or vice versa.

Although the total LCQ score provides a general overview of the impact and severity of cough, analyzing the scores of the individual domains may offer more detailed insights into effective management of condition. A comprehensive assessment, which includes the evaluation of the perception of patients with their psychosocial dysfunction, should be conducted. If the psychological or social domain score is significantly higher than the physical domain score on the questionnaire, it is important to address the psychosocial well-being of patients during counseling and education. This approach can help physicians provide appropriate guidance and support to patients. A recent study revealed that adults with chronic cough experience a disproportionate burden of depressive symptoms and are at a higher risk for recurrent depression [28], highlighting the importance of addressing the psychosocial factors of chronic cough.

Our study has several limitations. Firstly, only Korean patients were included, and the psychological and social impacts of cough may not necessarily be identical in other cultures. It is important to assess the generalizability of our results in different countries in future studies. Second, the number of included patients was relatively small, and patients with various causes of chronic cough were unevenly represented. In addition, while we acknowledge that including other multidimensional questionnaires, such as the 36-item Short-Form Survey, could provide additional support for our classification, we were unable to perform further analyses due to the absence of such data in our study. Although our study was externally validated, further validation is required to confirm our results in a larger cohort of patients with varying causes of cough. Finally, we did not present any results on how the reclassification of the K-LCQ may affect the assessment or management of patients in actual clinical practice. Further research is required to explore the practical implications of our findings and how they can be applied to improve patient care. Nevertheless, we believe that our analyses provide valuable insights into the complex interrelationship between cough and its impacts on different domains of quality of life, which can ultimately lead to an improvement in patient management.

5. Conclusion

Our study found complex inter-correlations between items in the physical, psychological, and social domains of the K-LCQ through correlation and network analyses. The reclassification of the items has led to improved coherence in each domain. Further studies are required to determine the clinical implications of this reclassification.

Ethical approval and consent to participate

The Institutional Review Board of Ilsan Paik Hospital approved the study protocol in 20180212 (No. 2017-12-025) and waived the need for informed consent due to the retrospective nature of the study.

Consent for publication

Not applicable.

Financial support

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT: No. 2021R1G1A1095110, RS-2024-00359875). The funding bodies played no role in the study design, data collection, analysis, interpretation, and writing of the manuscript.

Declaration of competing interest

The authors have no conflicts of interest.

Acknowledgement

None.

Appendix A Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.resinv.2024.09.017>.

References

- [1] Andrani F, Aiello M, Bertorelli G, Crisfulli E, Chetta A. Cough, a vital reflex. mechanisms, determinants and measurements. *Acta Biomed* 2019;89:477–80.
- [2] Irwin RS, Boulet LP, Cloutier MM, Fuller R, Gold PM, Hoffstein V, et al. Managing cough as a defense mechanism and as a symptom. A consensus panel report of the American College of Chest Physicians. *Chest* 1998;114:81s–133s.
- [3] Spanevello A, Beghé B, Visca D, Fabbri M, Papi A. Chronic cough in adults. *Eur J Intern Med* 2020;78:8–16.
- [4] Won HK, Song WJ. Impact and disease burden of chronic cough. *Asia Pac Allergy* 2021;11:e22.
- [5] Baiardini I, Braido F, Fassio O, Terantini F, Pasquali M, Tarchino F, et al. A new tool to assess and monitor the burden of chronic cough on quality of life: chronic Cough Impact Questionnaire. *Allergy* 2005;60:482–8.
- [6] Birring SS, Prudon B, Carr AJ, Singh SJ, Morgan MDL, Pavord ID. Development of a symptom specific health status measure for patients with chronic cough: leicester Cough Questionnaire (LCQ). *Thorax* 2003;58:339–43.
- [7] Faruqi S, Thompson R, Wright C, Sheedy W, Morice AH. Quantifying chronic cough: objective versus subjective measurements. *Respirology* 2011;16:314–20.
- [8] French CT, Irwin RS, Fletcher KE, Adams TM. Evaluation of a cough-specific quality-of-life questionnaire. *Chest* 2002;121:1123–31.
- [9] Barton A, Gaydecki P, Holt K, Smith JA. Data reduction for cough studies using distribution of audio frequency content. *Cough* 2012;8:12.
- [10] Spinou A, Birring SS. An update on measurement and monitoring of cough: what are the important study endpoints? *J Thorac Dis* 2014;6:S728–34.
- [11] Boulet LP, Coeytaux RR, McCrory DC, French CT, Chang AB, Birring SS, et al. Tools for assessing outcomes in studies of chronic cough: CHEST guideline and expert panel report. *Chest* 2015;147:804–14.
- [12] Kwon JW, Moon JY, Kim SH, Song WJ, Kim MH, Kang MG, et al. Reliability and validity of a Korean version of the leicester cough questionnaire. *Allergy Asthma Immunol Res* 2015;7:230–3.
- [13] Koo HK, Bae W, Moon JY, Lee H, Kim JW, Jang SH, et al. Differential features of chronic cough according to etiology and the simple decision tree for predicting causes. *Sci Rep* 2021;11:10326.

- [14] Martin MJ, Harrison TW. Causes of chronic productive cough: an approach to management. *Respir Med* 2015;109:1105–13.
- [15] McGarvey LP, Heaney LG, Lawson JT, Johnston BT, Scally CM, Ennis M, et al. Evaluation and outcome of patients with chronic non-productive cough using a comprehensive diagnostic protocol. *Thorax* 1998;53:738–43.
- [16] Chung KF, McGarvey L, Song WJ, Chang AB, Lai K, Canning BJ, et al. Cough hypersensitivity and chronic cough. *Nat Rev Dis Primers* 2022;8:45.
- [17] Goldsobel AB, Kelkar PS. The adult with chronic cough. *J Allergy Clin Immunol* 2012;130:825–825.e826.
- [18] Hulme K, Deary V, Dogan S, Parker SM. Psychological profile of individuals presenting with chronic cough. *ERJ Open Res* 2017;3(1):99–2016.
- [19] Rhee CK, Jung JY, Lee SW, Kim JH, Park SY, Yoo KH, et al. The Korean cough guideline: recommendation and summary statement. *Tuberc Respir Dis* 2016;79:14–21.
- [20] Hull JH, Langerman H, Ul-Haq Z, Kamalati T, Lucas A, Levy ML. Burden and impact of chronic cough in UK primary care: a dataset analysis. *BMJ Open* 2021;11:e054832.
- [21] Chamberlain SA, Garrod R, Douiri A, Masefield S, Powell P, Bucher C, et al. The impact of chronic cough: a cross-sectional European survey. *Lung* 2015;193:401–8.
- [22] Birring SS, Matos S, Patel RB, Prudon B, Evans D, Pavord ID. Cough frequency, cough sensitivity and health status in patients with chronic cough. *Respir Med* 2006;100:1105–9.
- [23] Kelsall A, Decalmer S, Webster D, Brown N, McGuinness KM, Woodcock A, et al. How to quantify coughing: correlations with quality of life in chronic cough. *Eur Respir J* 2008;32:175–9.
- [24] Decalmer SC, Webster D, Kelsall AA, McGuinness K, Woodcock AA, Smith JA. Chronic cough: how do cough reflex sensitivity and subjective assessments correlate with objective cough counts during ambulatory monitoring? *Thorax* 2007;62:329–34.
- [25] Chang AB, Phelan PD, Robertson CF, Roberts RGD, Sawyer SM. Relation between measurements of cough severity. *Arch Dis Child* 2003;88:57–60.
- [26] French CL, Irwin RS, Curley FJ, Krikorian CJ. Impact of chronic cough on quality of life. *Arch Intern Med* 1998;158:1657–61.
- [27] Kang SY, Won HK, Lee SM, Kwon JW, Kim MH, Jo EJ, et al. Impact of cough and unmet needs in chronic cough: a survey of patients in Korea. *Lung* 2019;197:635–9.
- [28] Arinze JT, Hofman A, de Roos EW, de Ridder MAJ, Verhamme KMC, Stricker B, et al. The interrelationship of chronic cough and depression: a prospective population-based study. *ERJ Open Res* 2022;8(2):69–2022.