Validity study of the Japanese version of the Nijmegen Questionnaire for verifying dysfunctional breathing in Japanese asthma patients

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Background: Dysfunctional breathing (DB) is a clinical condition characterized by irregular breathing patterns presenting a sensation of dyspnea and a feeling of chest tightness. DB is a known comorbidity of asthma that is difficult to control, leading to poor quality of life, so early diagnosis and therapeutic intervention are essential to improve the clinical condition of asthma. The Nijmegen Questionnaire (NQ), developed to screen for DB and translated into various languages, is used worldwide. However, a Japanese NQ (JNQ) is unavailable, so DB has not been clinically verified in people with asthma in Japan.

Objective: This study aimed to prepare a JNQ, verify its reliability and validity, and demonstrate its clinical benefits in asthma treatment.

Methods: The JNQ was prepared by back-translating the NQ with the author's consent. The answers to self-administered questionnaires, including the JNQ, Asthma Control Test (ACT), Asthma Control Questionnaire (ACQ), Mini Asthma Quality of Life Questionnaire (Mini-AQLQ), and Patient Health Questionnaire 9 (PHQ-9), were obtained with the consent of 68 people with asthma (average age ± SD, 52.04 ± 12.43 years) who visited Nihon University Itabashi Hospital. The reliability of the JNQ was analyzed by the Cronbach alpha coefficient. A comparative test was conducted for each questionnaire (ACT, ACQ, Mini-AQLQ, PHQ-9), considering a JNQ score of 23 as the cutoff value. Patients with a score of 23 or more were assigned to the DB group, whereas patients with a score of less than 23 were assigned to the non-DB group. We analyzed the correlation between the JNQ and each questionnaire.

Results: The JNQ showed sufficient reliability (Cronbach alpha = 0.875). Correlation analysis between the JNQ score and each questionnaire revealed negative correlations with the ACT score ($r = 0.262$) and Mini-AQLQ score ($r = -0.453$) and positive correlations with the ACQ score ($r = 0.337$) and PHQ-9 score ($r = 0.539$). All of these correlations were statistically significant. As a result of the comparative test, the DB and non-DB groups showed a significant difference in Mini-AQLQ ($P = .023$) and PHQ-9 ($P = .003$) scores. No significant difference was observed between ACT ($P = .294$) and ACQ ($P = .177$) scores.

Conclusions: The JNQ validates DB in Japanese people with asthma and reflects the deterioration of asthma control, decreased quality of life, and depression. Using the JNQ, early diagnosis and therapeutic intervention (eg, breathing exercises and a psychosomatic approach) for DB in people with asthma may help suppress the severity of asthma in Japan. (J Allergy Clin Immunol Global 2024;3:100247.)

Key words: *Asthma, dysfunctional breathing, Nijmegen Questionnaire*

Dysfunctional breathing (DB) is a clinical condition that causes irregular breathing patterns due to environmental factors, including psychosocial factors.[1] Typical symptoms are the feeling of a tight chest, chest pain, deep sighing, exercise-induced shortness of breath, frequent yawning, and hyperventilation.[2,3] The Nijmegen Questionnaire (NQ) used for diagnosis was prepared by the University of Nijmegen in the Netherlands to evaluate the severity of hyperventilation syndrome patients.[4] It considers symptomatic hyperventilation and has satisfactory reliability and validity.[4] The NQ has been used to assess not only hyperventilation syndrome but also the coexistence of DB in patients with respiratory diseases, such as asthma,[5,6] chronic obstructive pulmonary disease,[7] and long COVID-19 (long COVID-19 refers to persistent symptoms after coronavirus disease 2019 infection).[8] The most studied is DB as an asthma comorbidity; DB comorbidity is present in about 29% of people with asthma and 30% to 64% of patients with severe asthma.[9] Asthmatic patients with DB have anxiety, depression, and nasal symptoms, leading to severe asthma[6] and significantly reducing quality of life (QOL).[10] Therefore, evaluation and treatment of DB are essential in managing severe asthma. DB in people with asthma was evaluated using an NQ score of 23 as the cutoff value.[5,10] The NQ has been translated into various languages, including Greek, Norwegian, Persian, Hangul (Korean), and Thai.[11-14]

Multidisciplinary treatment for DB with asthma, including a psychosomatic approach involving mental health care, breathing techniques, and relaxation methods, has demonstrated clinical efficacy.[15] A psychosomatic approach to DB may help improve

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Abbreviations used
ACQ: Asthma Control Questionnaire
ACT: Asthma Control Test
COVID-19: Coronavirus disease 2019
DB: Dysfunctional breathing
JNQ: Japanese NQ
Mini-AQLQ: Mini Asthma Quality of Life Questionnaire
NQ: Nijmegen Questionnaire
PCA: Principal component analysis
PHQ-9: Patient Health Questionnaire 9
QOL: Quality of life

the QOL of patients with asthma and respiratory and psychosomatic symptoms. Despite the apparent usefulness of the NQ to diagnose DB and therapeutic intervention in preventing the severity of asthma, given that a Japanese-language NQ is unavailable, the DB has not been clinically verified in asthmatic patients in Japan. There is also no study of its relationship with patient psychosocial background or QOL in Japan.

We prepared a Japanese-language version of the NQ to determine the reliability and effectiveness of the questionnaire for measuring DB and its relationship with asthma control, QOL, and depression. We verify that the JNQ is a valuable tool for screening DB in asthmatic patients in Japan, and we also demonstrate its most important clinical benefits when used to treat asthma.

METHODS

The protocol for this study was approved by the Nihon University School of Medicine Itabashi Hospital clinical research ethics review board (approval RK-191008-02). This study was performed in accordance with the principles of the Declaration of Helsinki. We prepared the JNQ with permission from Jan van Dixhoorn, who developed the original NQ. The study flowchart is shown in Fig 1.

Preparation of JNQ

In the first step, the Japanese version (version B) of the English NQ was prepared by direct translation into Japanese by several bilingual Japanese speakers. The English questions were summarized using concise phrasing, and the directly translated questionnaire was considered adequate for the clinician to check the self-reported condition of the patient. With the aim that the patients could use it as a self-administered questionnaire, a version (version A) that phrased the direct translation into plain and easy-to-understand Japanese was also prepared. Then retranslation from Japanese to English was outsourced to a third-party translator. The English-language content was verified by a university faculty member who was a native speaker of English. We confirmed that the contents differed from those of the NQ. This survey was conducted using both versions, A and B. Here we focus on the results of version A, which uses easy-to-understand expressions to permit its use as a self-administered questionnaire (see Fig E1 in this article's Online Repository at www.jaci-global.org).

Survey of asthmatic patients

Sixty-eight patients diagnosed with bronchial asthma who visited the department of respiratory medicine at Nihon University Itabashi Hospital were asked to provide basic information and complete versions A and B of the JNQ and a self-administered questionnaire containing the Asthma Control Test (ACT), Asthma Control Questionnaire (ACQ), Mini Asthma Quality of Life Questionnaire (Mini-AQLQ), and a depression rating scale, the Patient Health Questionnaire 9 (PHQ-9). We obtained informed consent in writing from all patients.

Questionnaires used

The JNQ consists of 16 items on a 5-point Likert scale. Based on severity, each item has a scale ranging from 0 (never) to 4 (very often [almost every day]). The total score is 64. A score of 0 indicates an asymptomatic patient to whom none of the items are applicable, and a score of 64 indicates a patient with a maximum rating for everything. A total score of 23 or more denotes the presence of DB.

This study was intended for asthmatic patients, so we also used asthma-related questionnaires, such as the ACT, ACQ, and Mini-AQLQ. We added the PHQ-9 for evaluating depression because asthma has a psychosomatic aspect.

Verification of reliability and validity of JNQ

On the basis of the responses from 68 asthmatic patients, a statistical examination was conducted to evaluate the reliability and validity of the JNQ. We analyzed 2 essential properties in measuring evaluation items in a questionnaire. First, we assessed the reliability using the commonly used Cronbach alpha coefficient. This is a confidence coefficient that is widely used to evaluate whether each question item (variable) measures the same concept or target as a whole (internal consistency) when using the total value (scale score) of the answers from multiple question items in the questionnaire as a characteristic scale and takes a value in the range of 0 to 1. Reliability increases as its value approaches 1; in general, reliability is considered high if it is 0.8 or more. In this study, 0.8 was also used as the judgment criterion.

Analysis of principal components

Next, the construct validity of how appropriately the construct is to be measured was confirmed by principal component analysis (PCA). A construct validity test based on PCA verified which question content gave a high score to asthmatic patients.

Analysis of correlation with asthma-related questionnaire

To verify how DB in asthmatic patients is associated with asthma control and QOL, correlation analysis and a comparative test using the cutoff value of the total score of the NQ were conducted for the JNQ and other questionnaires—that is, association with external criteria (criterion-referenced validity). On the basis of the report by Veidal et al[16] in which the NQ score judged the DB, the total scores of the JNQ were divided into 2 groups, one with a cutoff value of less than 23 points (non-DB group) and another with a cutoff of 23 or more points (DB group). There were 4 questionnaires used as external criteria: ACT and

1. Preparation of the JNQ
Step 1: Several Japanese bilingual speakers prepared a Japanese literal translation (version B) from the English version of the NQ.
Step 2: The medical staff prepared a revised version (version A) of the literal translation into simple Japanese.
Step 3: A third-party translator prepared a reverse translation from the Japanese version (version B) into English.
Step 4: A university faculty member, a native English speaker, verified the reverse-translated version and confirmed that the content was not different from that of the NQ.

2. Survey of asthmatic patients
The answers for basic information, versions A and B of the JNQ, and a self-administered questionnaire containing the MiniAQLQ, ACT, ACQ, and PHQ-9 were given to 68 patients diagnosed with bronchial asthma who visited the Department of Respiratory Medicine at Nihon University Itabashi Hospital. Written informed consent was obtained from all patients.

3. Verification of the reliability and validity of the JNQ
Based on the answers of the 68 patients, a statistical study was conducted to evaluate the reliability and validity of the JNQ.

FIG 1. Protocol for preparing JNQ and verifying its reliability and validity.

ACQ, which are asthma control tests; Mini-AQLQ, which is a simple asthma QOL questionnaire; and PHQ-9, which is a depression rating scale.

Statistical analysis

Fisher direct probability confirmed a sex difference between the DB and non-DB groups. The difference in each score on the ACT, ACQ, Mini-AQLQ, and PHQ-9 between the DB and non-DB groups was evaluated by a 2-way analysis of variance with sex as a covariate. We assessed the relationship between the total score on the JNQ and the external criteria by drawing a correlation diagram (scatter diagram) and calculating the Pearson correlation coefficient, unless extreme bias was observed in the data distribution in the scatter diagram. Similarly, we used the unpaired *t* test as the comparative test of the external criteria that used a cutoff value of the JNQ's total score. We also used SPSS Statistics 25 (IBM, Armonk, NY) and BellCurve for Excel 3.21 (Social Survey Research Information, Tokyo, Japan) as statistical analysis software. When conducting the test, the significance level was considered $\alpha = 0.05$ (both sides), and $P < .05$ indicated a statistically significant difference.

RESULTS

Patient background

We registered 68 asthmatic patients who visited Nihon University Itabashi Hospital, including 20 men and 48 women (average age ± SD, 52.0 ± 12.4 years) (Table I). No significant association was observed between sex and the DB/non-DB group, which we classified by the total score on the JNQ as 23 or more or less than 23, respectively. This result was the same as in a previous report.[13] Regarding confirmation, the mutual association between the DB group/non-DB group that was based on JNQ score did not match completely, but a highly significant association was observed.

Verification of reliability and validity of JNQ

No floor or ceiling effect was observed in the JNQ. Additionally, no floor or ceiling effect was observed for the items from the other 4 questionnaires. Therefore, in studying the validity of the JNQ, it was determined to be appropriate to compare the question items with those from the other 4 questionnaires. The reliability of the JNQ was confirmed by the Cronbach alpha coefficient. The Cronbach alpha coefficient for the entire JNQ was 0.875, ensuring that the JNQ had sufficient reliability. In addition, the alpha coefficient obtained from other question items when each was excluded one by one was in the range of 0.86 to 0.88, and nothing with a prominently high value was observed (Table II). If the alpha coefficient obtained from other question items increased when we deleted a question item, then that item contributed to lowering the overall alpha coefficient, and it would not have been an appropriate question item. Therefore, we confirmed that such a problem item was not observed in the JNQ.

TABLE I. Characteristics of study population

Factor	Value	No.
Age (years): Mean ± SD	52.0 ± 12.4	68
Sex: Female, no. (%)	48 (70.6%)	68
Height (cm): Mean ± SD	161.5 ± 8.1	68
Weight (kg): Mean ± SD	62.2 ± 14.7	68
Duration of illness (years): Mean (min-max)	22.7 (1-60)	58
Smoking history (no.): Mean (min-max)	23.6 (5-60)*	19
Smoking history (years): Mean (min-max)	19.1 (5-32)*	18
Smoking history (no. × years): Mean (min-max)	436.9 (25-1500)*	18
Family history of asthma: Yes, no. (%)	27 (39.7%)	68
Atopic dermatitis: Yes, no. (%)	22 (32.4%)	68
Allergic rhinitis: Yes, no. (%)	51 (75.0%)	68
Current skin symptoms: Yes, no. (%)	15 (22.1%)	68
Exacerbations in past year: Mean (min-max)	14.8 (1-365)†	33

*Excluding nonsmokers and patients who did not answer.
†Excluding patients who answered 0.

Analysis of principal components

We used the PCA method to confirm what type of disease-related components each question item of the JNQ contained. Table III summarizes the 3 typical main components extracted by the PCA method, as follows. Central component 1 includes

TABLE II. JNQ validity study

Characteristic	Cronbach alpha
Overall	0.8750
Evaluation when each variable was deleted	
1. Chest tingling/pain	0.8713
2. Stiffness or tightness of body	0.8626
3. Blurred vision	0.8767
4. Dizziness	0.8687
5. Confusion, inability to concentrate	0.8688
6. Deep breathing, such as hyperpnea and tachypnea	0.8656
7. Shortness of breath	0.8724
8. Tight feeling in chest	0.8670
9. Bloated stomach, upset stomach	0.8676
10. Tingling fingers	0.8701
11. Unable to breathe deeply	0.8650
12. Stiffness in fingers	0.8665
13. Tightness around mouth	0.8737
14. Cold hands or feet	0.8585
15. Palpitations	0.8633
16. Anxiety, insomnia	0.8647

TABLE III. Principal components extracted in PCA of answers to JNQ

Question item	Value
A. Component 1	
14. Cold hands or feet	0.7580
2. Stiffness or tightness of body	0.7056
15. Palpitations	0.6891
16. Anxiety, insomnia	0.6690
11. Unable to breathe deeply	0.6582
6. Deep breathing, such as hyperpnea and tachypnea	0.6367
8. Tight feeling in chest	0.6285
12. Stiffness in fingers	0.6197
B. Component 2	
7. Shortness of breath	0.5094
6. Deep breathing, such as hyperpnea and tachypnea	0.4632
C. Component 3	
1. Chest tingling/pain	0.4382
9. Bloated stomach, upset stomach	0.3076

neuropsychological parts, such as Cold hands or feet, Stiffness or tightness of body, Palpitations, and Anxiety, insomnia. Principal component 2 includes respiratory components, such as Shortness of breath and Deep breathing, such as hyperpnea and tachypnea. Principal component 3 includes neurogastrointestinal components, such as Chest tingling/pain and Bloated stomach, upset stomach. We determined that the asthmatic patients' characteristics targeted in this study could be extracted as the principal components, and the validity of the constructs of the JNQ was confirmed.

Relationship between DB and asthma-related questionnaires

Next, we analyzed the correlation with the asthma-related questionnaires. Fig 2, *A,* shows the correlation between the total score on the ACT and the total score on the JNQ. The correlation coefficient between the two was $R = -0.262$. The significance probability was $P = .034$, indicating a significant negative correlation and a valid result that lowers the total ACT score (ie, the poorer the control of asthma, the higher the total score on the JNQ). Fig 2, *B,* compares the ACT distribution in a box plot by dividing the total score on the JNQ into 2 groups, one group with a score of less than 23 and the other with a score of 23 or more. When we compared the total ACT score between the 2 groups by unpaired *t* test, there was no significant difference between the 2 groups ($P = .294$).

Fig 3, *A,* shows the correlation between the total score on the ACQ and the total score on the JNQ. The correlation coefficient between the two was $R = 0.337$, and the significance probability was $P = .005$, indicating a significant positive correlation and a valid result that the higher the total score of the ACQ (ie, the poorer the asthma control), the higher the total score on the JNQ. Fig 3, *B,* compares the ACQ distribution in a box plot by dividing DB into 2 groups, one with a total JNQ score of less than 23 and the other with a score of 23 or more. No significant difference was observed when we compared the total ACQ score between the 2 groups by unpaired *t* test ($P = .177$).

Fig 4, *A,* shows the correlation between the total score on the Mini-AQLQ and the total score on the JNQ. The correlation coefficient between the two was $R = -0.453$, and the significance probability was $P < .001$, indicating a significant negative correlation and a valid result that the lower the total score on the Mini-AQLQ (ie, the poorer the QOL relating to asthma), the higher the total score is on the JNQ. Fig 4, *B,* compares the Mini-AQLQ distribution in a box plot by dividing DB into 2 groups, one with a total JNQ score of less than 23 and the other with a score of 23 or more. When we compared the total Mini-AQLQ score between the 2 groups by unpaired *t* test, a significant difference between the 2 groups ($P = .023$) was observed. The group with a score of 23 or more had a significantly lower Mini-AQLQ score than the group with a total JNQ score of less than 23.

Fig 5, *A,* shows the correlation between total PHQ-9 score (a depression rating scale) and total JNQ score. The correlation coefficient between the two was $R = 0.539$, and the significance probability was $P < .001$, indicating a significant positive correlation and a valid result that the higher the total score on the PHQ-9 (ie, the higher the severity of depression), the higher the total score on the JNQ. Fig 5, *B,* compares the PHQ-9 distribution in a box plot by dividing DB into 2 groups, one with a total JNQ score of less than 23 and the other with a score of 23 or more. A significant difference was observed when we compared the total PHQ-9 score between the 2 groups by unpaired *t* test ($P = .003$). The group with a score of 23 or more had a significantly higher PHQ-9 score than the group with a total JNQ score of less than 23.

The above shows that the JNQ shows a significant positive correlation with the ACT, ACQ, and PHQ-9 and a significant negative correlation with the Mini-AQLQ. Therefore, the JNQ shows criteria associated with validity compared to existing external standards. The ACT, ACQ, Mini-AQLQ, and PHQ-9 significantly correlated in all the combinations studied. We believed that each questionnaire measures different intended scales while correlating with each other to some extent, whether positively or negatively. According to the PCA, the main component of each question item could not be clearly divided into the principal components of each question item, like the survey result[13] of the Hangul (Korean) NQ. Nevertheless, the characteristics of asthmatic patients could be extracted as

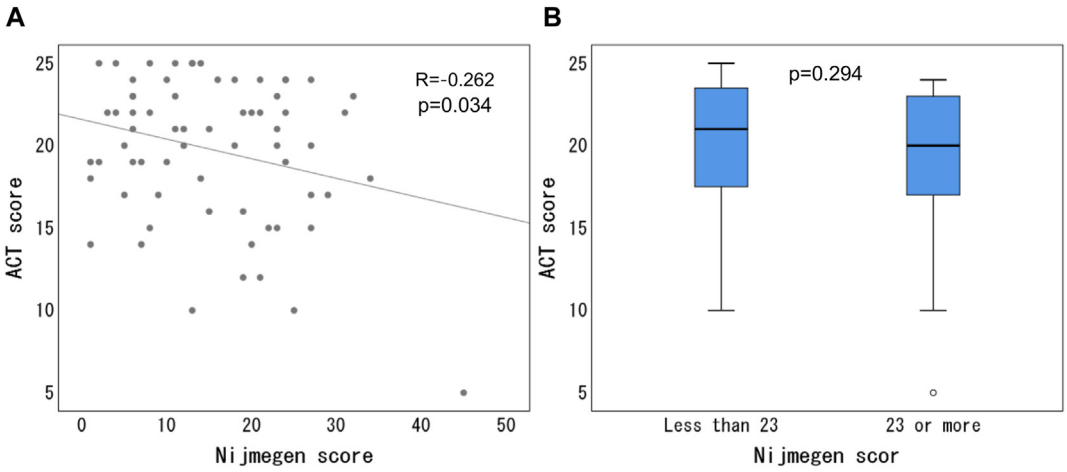

FIG 2. Relationship between JNQ and ACT values in people with asthma **A,** Scatter diagram. Correlation between total ACT score and total JNQ score was observed. **B,** DB group versus non-DB group. ACT distribution was compared in box plot by dividing total score of JNQ into 2 groups, one with score of less than 23 and other with score of 23 or more. Total ACT score between 2 groups was compared by unpaired *t* test.

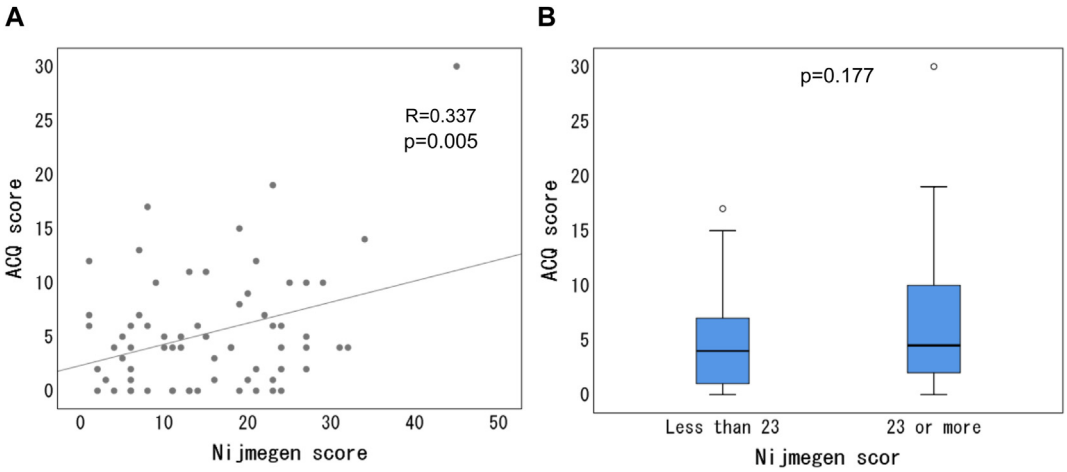

FIG 3. Relationship between JNQ and ACQ values in people with asthma **A,** Scatter diagram. Correlation between total ACQ score and total score on JNQ was observed. **B,** DB group versus non-DB group. ACQ distribution was compared in box plot by dividing DB into 2 groups, one with total JNQ score of less than 23 and other with score of 23 or more. Total ACQ score between 2 groups was compared by unpaired *t* test.

the principal components. Including other survey results, JNQ was considered valid as a Japanese version of the NQ.

DISCUSSION

In this study, we examined the characteristics of DB in asthmatic patients in Japan after preparing the JNQ and verifying its validity as a questionnaire. This report compiles the self-administered results of patients using version A of the questionnaire converted into simple Japanese. Our results suggest that the JNQ is helpful in evaluating DB in asthmatic patients in Japan, whose disease may lead to depression and decreased QOL.

So far, research on DB's coexistence in clinical asthma conditions has been conducted mainly in Europe and the United States. These reports estimate the presence of an asthma phenotype with psychosomatic aspects where the clinical needs of asthma with DB could not be classified by biological or physiologic evaluation. Because a Japanese version of the NQ was unavailable, it was impossible to check this phenotype's presence. Therefore, by preparing the JNQ and demonstrating its reliability and validity, our study in Japan is useful for managing Japanese asthmatic patients to verify the coexistence of DB and its characteristics.

Ok et al[13] focused on items with a principal component value of 0.5 or more, classifying them into 4 factors: neuropsychological (factor 1), respiratory (factor 2), neurogastrointestinal (factor 3), and neuromuscular (factor 4). In our study, principal component 1 (factor 1) was the predominant component in answers to this survey. Looking at the items with a principal component value of 0.6 or more, central component 1 contains the following 8 factors (numbers refer to numbering in Table II): 14 Cold hands or feet, 2 Stiffness or tightness of body, 15 Palpitations, 16 Anxiety, insomnia, 11 Unable to breathe deeply, 6 Deep breathing, such as hyperpnea and tachypnea, 8 Tight feeling in chest, and

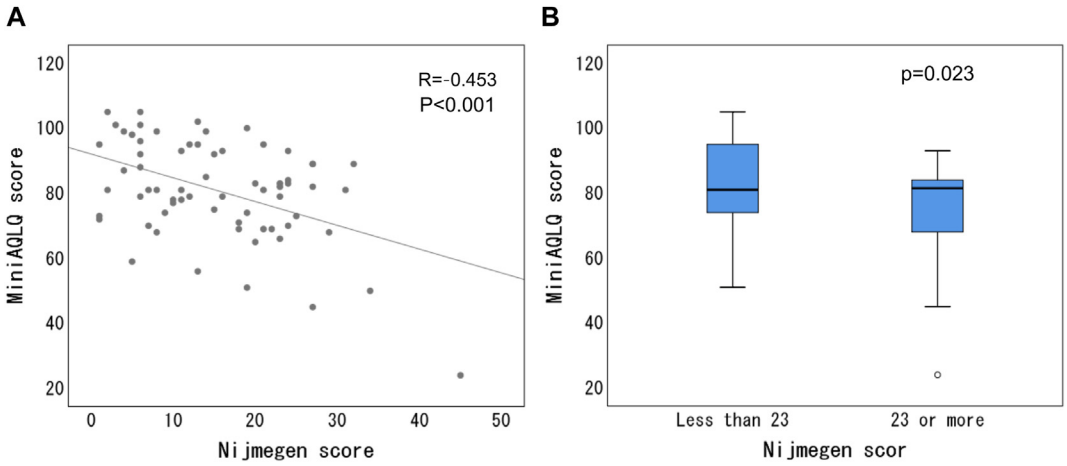

FIG 4. Relationship between JNQ and Mini-AQLQ values in people with asthma. **A,** Scatter diagram. Correlation between total Mini-AQLQ score and total score on JNQ was observed. **B,** DB group versus non-DB group. Mini-AQLQ distribution was compared in box plot by dividing DB into 2 groups, one with total JNQ score of less than 23 and other with score of 23 or more. Total Mini-AQLQ score between 2 groups was compared by unpaired *t* test.

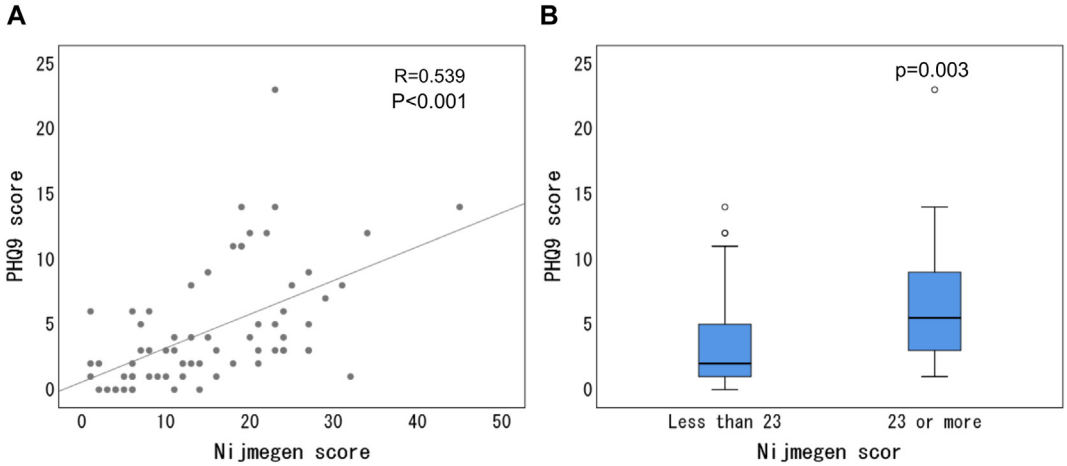

FIG 5. Relationship between JNQ and PHQ-9 values in people with asthma. **A,** Scatter diagram. Correlation between total PHQ-9 score, depression rating scale, and total score on JNQ was observed. **B,** DB group versus non-DB group. PHQ-9 distribution was compared in box plot by dividing DB into 2 groups, one with total JNQ score of less than 23 and other with score of 23 or more. Total PHQ-9 score between 2 groups was compared by unpaired *t* test.

12 Stiff fingers. These factors mainly indicate the neuropsychological component. In principal component 2, only 7 Shortness of breath had a value of 0.5 or more, and only one item, 6 Deep breathing, such as hyperpnea and tachypnea, had a value of 0.4 or more. These factors mainly indicate the respiratory component. In principal component 3, there was no factor with a value of 0.5 or more, and only 1 Chest tingling/pain had a value of 0.4 or more. This factor indicates the neuromuscular component. Principal component 4 had a factor (5 Confusion, inability to concentrate) with a value of 0.5 or more. Therefore, the JNQ is a questionnaire that can be verified regarding neuropsychological and respiratory factors as the principal components in the same manner as the versions translated into other languages.[13]

In this study, we used the internationally most used NQ score of 23 points as the cutoff value for DB in people with asthma. On the one hand, it has been reported that typical values differ according to race in several studies in English, Belgian, and Dutch subjects and range from 10 to 12 ± 7 (mean ± SD). On the other hand, normal Chinese subjects score much lower: 4.7 ± 4.6. This indicates that the cutoff value for DB in Japanese people with asthma may differ in cutoff values of 23 points, depending on race. Using the Mini-AQLQ as an external standard, the minimum *P* value of the difference between groups above and below the cutoff value was calculated when the JNQ cutoff value was decreased from 23, the standard, to 15, in increments of 1. As a result, the *P* value closest to 23 satisfying the highly significant level $\alpha = 0.01$ was $P = .006$, and the cutoff value in that case was 19 points (see Table E1 in the Online Repository at www.jaci-global.org). This value was consistent with the cutoff value reported by van Dixhoorn's group[1] and was considered to be a cutoff that highly

and significantly discriminated between the presence or absence of DB affecting QOL in asthma for the Japanese population.

The results of the correlation analysis between the JNQ and the existing questionnaires indicated that the JNQ is reliable and valid. A weak correlation was observed with the asthma control rating scale. Still, a statistically significant difference was not observed in the comparison between the DB and the non-DB groups. This finding suggests that the JNQ can extract new uncontrolled asthma phenotypes that cannot be found with the existing asthma control rating scale. The JNQ prepared indicated that asthmatic patients with DB had decreased QOL and tended toward depression. This same result was found in a previous report.[16]

Asthma is a typical respiratory psychosomatic disease that may be aggravated or become intractable as a result of psychosocial stress and the coexistence of depression. In patients with severe asthma, the NQ score and Toronto Alexithymia Scale score, which evaluates a psychological trait characterized by difficulty perceiving and expressing emotions and body sensations,[17] are positively correlated.[18] DB correlates with psychosomatic phenotypes like alexithymia and is associated with poor QOL. Therefore, identifying the presence of a psychosomatic phenotype using the JNQ is essential for managing DB with asthma because the multidisciplinary treatment, including breathing exercises, relaxation techniques, and pathological education, has demonstrated clinical efficacy.[15] The therapeutic intervention using a psychosomatic approach, such as counseling, autogenic training, or cognitive behavioral therapy, may affect DB with severe asthma.

There are several limitations in this study. The number of asthmatic subjects was small, and there was gender bias (predominantly female). The number of asthmatic subjects with DB was also small. Additionally, the correlation between the presence or absence of DB comorbidity and clinical data of asthmatic patients such as eosinophils, IgE, allergens, exhaled nitric oxide, or respiratory function test has not been analyzed. In addition, we should remeasure the cutoff value for DB in Japanese people with asthma because of the possibility of differences in cutoff values depending on race.[1] A large prospective multicenter cohort study of DB in Japanese people with asthma will be needed to investigate the correlation between the presence of DB and clinical data, including asthma biomarkers, using the JNQ in the future. In addition, the effect of therapeutic intervention using a psychosomatic approach is one of the topics of future studies.

Furthermore, Steinmann et al[19] reported that breathing vigilance is involved in the onset of DB, and they developed Breathe-VQ, a questionnaire for diagnosing breathing vigilance. Vlemincx et al[20] reported that diagnosing DB requires a dimensional, transdiagnostic perspective that includes breathing vigilance. Breathing vigilance might be one of the aspects we should focus on to verify DB in Japanese people with asthma.

In conclusion, we conducted the JNQ as a self-administered questionnaire and confirmed its verification in terms of reliability and validity to assess DB in Japanese people with asthma. The JNQ may be used as a self-administered questionnaire to evaluate DB comorbidity in asthma in primary care and deserves wide use. The multidisciplinary therapeutic interventions, including psychosomatic treatments, may improve QOL of DB in asthmatic patients and help reduce disease severity. We hope Japanese clinicians in primary care will use the JNQ to gain insight into improving QOL of Japanese people with asthma.

DISCLOSURE STATEMENT

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Clinical implications

- **The JNQ can diagnose DB in Japanese people with asthma.**
- **DB in Japanese people with asthma was correlated with depression and poor QOL.**

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