Developing the Patient Healthy Questionnaire-8 with a Greater Impact on Quality of Life of Patients with Functional Dyspepsia Compared with the Somatic Symptom Scale-8

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Research article

Keywords: Patient Healthy Questionnaire-8, Functional Dyspepsia, Somatization, Somatic Symptom Scale-8, Reliability, Validity, Quality of life

Posted Date: May 27th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-25118/v1

Version of Record: A version of this preprint was published on October 28th, 2020. See the published version at https://doi.org/10.1186/s12876-020-01508-4.

Abstract

Background: To develop the Patient Healthy Questionnaire-8 (PHQ-8), as a more reliable approach compared with the Somatic Symptom Scale-8 (SSS-8), evaluating somatization in patients with functional dyspepsia (FD), in which the effects of somatization assessed by these two approaches on quality of life (QoL) of FD patients were further compared.

Methods: Herein, 612 FD patients completed a questionnaire involving 25 items. 8 out of 25 items were selected to develop the PHQ-8 by four methods of discrete degree, correlation coefficient, factor analysis, and Cronbach's α coefficient. Reliability and validity of the PHQ-8 and the SSS-8 were compared by principal component and confirmatory factor analyses. The effects of somatization, depression, and anxiety on the Nepean Dyspepsia Index (NDI) for QoL were explored by Pearson's correlation coefficient and linear regression analysis.

Results: The Cronbach's α coefficient for the PHQ-8 and the SSS-8 was 0.601 and 0.553, respectively, and the cumulative contribution rate of three extracted factors for the developed PHQ-8 and SSS-8 was 55.103% and 51.666%, respectively. Somatization evaluated by the PHQ-8 ($r=0.309$, $P<0.001$) and the SSS-8 ($r=0.281$, $P<0.001$) was found to be correlated with the NDI. The model used for the PHQ-8 showed that the values of chi-squared (χ^2), root mean square residual (RMR), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), and adjusted GFI (AGFI) were 31.247, 0.01, 0.042, 0.984, and 0.967, respectively. Linear regression analysis unveiled that somatization ($\beta=0.270$, $P<0.001$), anxiety ($\beta=0.163$, $P<0.001$), and depression ($\beta=0.136$, $P=0.003$) assessed by the PHQ-8 were correlated with the NDI; besides, somatization ($\beta=0.250$, $P<0.001$), anxiety ($\beta=0.156$, $P<0.001$), and depression ($\beta=0.155$, $P=0.001$) evaluated by the SSS-8 were correlated with the NDI.

Conclusions: The developed PHQ-8 showed to have a superior reliability and validity, and somatization assessed by the developed PHQ-8 showed have a greater influence on QoL of FD patients compared with the SSS-8. Our findings suggested that the developed PHQ-8 may improve fast assessment of the effects of somatization on FD patients in lieu of the SSS-8.

Background

The pathogenesis and subtypes of functional dyspepsia

Functional dyspepsia (FD) is characterized by bothersome epigastric pain or burning, postprandial fullness, or early satiation without evidence of structural disease. According to the statistics, the prevalence of FD is as high as 20~30% [1,2]. Its pathogenesis includes diverse mechanisms, such as infectious causes represented by Helicobacter pylori (*H. pylori*) [1-6], diet factor [1,7,8], gastric acid [1,9,10], delayed gastric emptying, impaired proximal gastric accommodation[1,11-13], visceral hypersensitivity [1,14-16], duodenal inflammation [1,17-18], genetic factors [19,20], and psychosocial factors (e.g., anxiety, depression, stress, etc.) [19-25]; besides, these factors may interact with each other under the participation of brain-gut axis [1,3,15]. Thus, FD is a disorder of gut-brain interaction, and it was classified into three

subtypes by Rome IV criteria: (1) epigastric pain syndrome (EPS): upper abdominal pain and/or burning discomfort of upper abdomen; (2) postprandial distress syndrome (PDS): postprandial fullness and early satiety; (3) the overlapped group of EPS and PDS [2].

FD patients with common somatization symptoms

In addition, FD patients often have dizziness, back pain, sleep disorders, fatigue [26], and other symptoms of digestive system that cannot be explained by biochemical and structural abnormalities. Clinically, these symptoms are called somatization symptoms [27,28]. Somatization is defined as a chronic mental disorder characterized by the presence of one or more frequently changing somatic symptoms, involving multiple systems and organs of the body [29]. Those symptoms often induce patients' incorrect understanding or excessive attention, imposing a huge economic burden to the society [30]. Somatization can coexist with other medical disorders, such as anxiety and depression, and it often makes other diseases more complex and changeable [31]. Additionally, it affects the severity of dyspepsia and the quality of life (QoL) of FD patients [32,33]. Somatization plays a more significant role in dyspepsia symptom severity (DSS) compared with gastric sensitivity, anxiety, and depression in FD patients [21]. Somatization is an independent risk factor for impaired QoL of FD patients, and a 5-year follow-up study demonstrated that proximal gastric accommodation, gastric emptying, and *H. pylori* infection were not found as risk factors [33]. Therefore, assessment of somatization is highly essential for studying FD patients.

Limitations of questionnaires for somatization

The symptoms of somatization disorder were widely assessed by the Patient Health Questionnaire-15 (PHQ-15) developed by Kroenke et al. [34]. However, the PHQ-15 includes a number of items overlapped with gastrointestinal symptoms in FD patients. Therefore, symptoms of somatization disorder have been investigated by the Patient Healthy Questionnaire-12 (PHQ-12) with the removal of three gastrointestinal symptoms, while both PHQ-12 and PHQ-15 showed to have dysmenorrhea or other items related to menstrual discomfort, making the gender score different [34-36].

On the other hand, symptoms of somatization disorder were evaluated by the Somatic Symptom Scale-8 (SSS-8) with satisfactory reliability and validity developed in the field of the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition) (DSM-5) [37-39]. Therefore, it was previously recommended to be a replacement for the PHQ-15 [40]. However, the SSS-8 is not a FD-specific scale for evaluating symptoms of somatization disorder, in which the relevant items may overlap with gastrointestinal symptoms. Subsequently, we developed the Patient Healthy Questionnaire-8 (PHQ-8) for assessing FD patients with symptoms of somatization disorder by adapting the SSS-8, and confirmed its reliability and validity. It was unveiled that the developed PHQ-8 had a greater influence on QoL of FD patients than the SSS-8.

Methods

Patients

From June 2017 to June 2018, patients who were suspected of having FD were admitted to the department of gastroenterology of our hospital. According to CONSORT guidelines, inclusion criteria were as follows: (1) patients who met Rome IV criteria [1], involving to have upper abdominal pain, a burning feeling in the upper stomach, postprandial fullness, early satiety of one or more symptoms, and no organic diseases' evidence related to the above-mentioned symptoms; existence of these symptoms for at least 6 months, as well as satisfying the Rome IV criteria for at least 3 months; (2) patients who aged ≥ 18 years old; and (3) patients whose level of education was primary school and above, and had a certain reading comprehension ability. Exclusion criteria were as follows: (1) patients with organic gastrointestinal diseases, including erosive esophagitis, Barrett's esophagus, etc., which were diagnosed by gastroscopy; (2) patients with systemic diseases, metabolic diseases, or malignant tumors diagnosed by B-scan ultrasound, blood routine and biochemical examinations; (3) patients with irritable bowel syndrome; (4) patients with gastroesophageal reflux disease with symptoms of acidic taste in the mouth, regurgitation, and heartburn; (5) having a history of abdominal surgery, such as cholecystectomy, intestinal resection, hysterectomy, or appendectomy; (6) patients who had recently taken anticholinergic drugs, antispasmodic and analgesic drugs, hormones, nonsteroidal and anti-inflammatory drugs, etc.; patients whose upper abdominal symptoms disappeared after eradicating *H. pylori* infection; (7) pregnant and lactating women; or (8) patients with psychosis and serious somatic diseases (e.g., anxiety and depression). The sample size was 395 patients in a developed IBS-specific somatization scale [27]. A minimum sample size of 300 patients achieved, ranging from a 95% confidence interval to equally split chance (50/50) according to the previously presented formula, which was 350 cases suggested by Creswell [41]. We used a sample size of above 400 patients. In developing the PHQ-8, FD patients accompanied with anxiety and depression were excluded, in order to avoid the interaction effects of anxiety, depression, and somatization disorders. However, previous studies showed that anxiety, depression, and somatization had mutual effects [21,33]. Therefore, in the clinical application of the developed PHQ-8, FD patients with anxiety and depression could be included.

Pool items for the development of the PHQ-8

According to the SSS-8, the PHQ-15 items and the most common clinical symptoms of somatization disorder, 25 symptoms were involved in the pool items: 1. back pain; 2. pain in arms, legs, or joints; 3. dysmenorrhea or menstrual other discomfort; 4. headaches; 5. chest pain; 6. shortness of breath; 7. dizziness; 8. fainting; 9. palpitation; 10. sexual life pain or other discomfort; 11. feeling tired or having low energy; 12. insomnia or other sleep problems; 13. numbness/stinging; 14. fatigue; 15. throat discomfort (e.g., foreign body sensation/dryness/pain etc.); 16. dry mouth; 17. excessive sweat; 18. hand/foot heavy feeling; 19. a burst of cold/fever; 20. memory loss/forgetfulness; 21. urinary frequency; 22. urinary pain /dysuria; 23. blurred vision; 24. neck and shoulder pain; and 25. muscle pain. 1–12 items were included in the original PHQ-15 [35], in which each item was scored by three-level as 0 ("not bothered at all"), 1 ("slightly bothered"), or 2 ("remarkably bothered"). The items of the developed PHQ-8 were completed by discrete degree method, correlation coefficient method, factor analysis method, and Cronbach's alpha.

All enrolled patients filled in the PHQ-15, the SSS-8, the Generalized Anxiety Disorder -7(GAD-7) [42] for anxiety, the Patient Health Questionnaire (PHQ-9) [43] for depression, the DSS [33], and the Nepean Dyspepsia Index-Short Form (NDI) [44]for QoL.

Items were selected by the four methods for the development of the PHQ-8

Discrete degree method: As low degree of dispersion of the selected item revealed poor ability of evaluation, thus, the items with high degree of dispersion were selected, and the degree of dispersion was measured by the standard deviation (SD) of scores of items, in which exclusion of the SD of the items was defined as < 0.5 [45].

Correlation coefficient method: An item with a correlation coefficient > 0.3 was selected according to Cohen's criteria [39].

Factor analysis with the principal component method: The common factor was extracted according to the feature root > 1, and the variance was maximized by orthogonal rotation to select an item with a factor load > 0.4. The Kaiser-Meyer-Olkin (KMO) and Bartlett's spherical tests were performed. The value of KMO < 0.5 is unsuitable for factor analysis, and in Bartlett's spherical test, P<0.01 can negate the zero hypothesis that the correlation matrix is a unit matrix, that is, there is a significant correlation between the variables [46].

Cronbach's α coefficient: The items were screened for internal consistency, and the Cronbach's α coefficient of the initial total scale was calculated. If the Cronbach's α coefficient increased after the deletion of an item, it can be concluded that the existence of an item may reduce the internal consistency [47].

DSS

The DSS score was calculated as sum of all eight symptoms: postprandial fullness, early satiation, epigastric pain, burning, bloating, belching, nausea, and vomiting by a 3-point scale (absent, mild, moderate, severe) [33] . The relationship among the DSS, the PHQ-8, and the SSS-8 was evaluated, and the effects of somatization, anxiety, and depression disorders on DSS were analyzed.

Measurement of psychological disorder

The PHQ-15 questionnaire was designed for somatization disorder, in which the severity of 15 symptoms was rated for the last 4 weeks by three-level as 0 ("not bothered at all"), 1 ("slightly bothered"), or 2 ("remarkably bothered")[34].The Somatic Symptom Scale-8 (SSS-8) composed of 8 somatic symptoms was also applied by three-level as 0 ("not bothered at all"), 1 ("slightly bothered"), or 2 ("remarkably bothered")[38].The Generalized Anxiety Disorder-7 (GAD-7) was utilized to measure the severity of GAD and diagnosis comorbidity in GAD (total score > 10-point) [42]. The PHQ-9 was employed to identify major depressive disorder (total score > 10-point), and nine items were rated on a 3-point Likert scale (0-3) [43].

Measurement of disease-specific QoL

The Short-Form Nepean Dyspepsia Index (SF-NDI) was used to measure FD patients' QoL: inference with work/study, tension, inference with daily activities, disputation to daily eating/drinking, knowledge toward/control over disease symptoms over the past 2 weeks. Each item was assessed with a 5-point scale from 0 (not at all), 1 (slightly), 2 (moderately), 3 (remarkably) to 4 (extremely) [44]. The relationships among the SF-NDI, the PHQ-8, and the SSS-8 as well as the effects of somatization, depression and anxiety disorders on FD patients' QoL were assessed.

Statistical analysis

SPSS 24.0 software (IBM, Armonk, NY, USA) was utilized to carry out statistical analysis. Quantitative data were expressed as mean ± SD, *t*-test was used for making comparison between two groups, and one-way analysis of variance (ANOVA) was used for comparing more than two groups. The qualitative data were presented by rate, and chi-square test was used for making comparison. Besides, AMOS 22.0 software was applied for confirmatory factor analysis; Pearson's correlation coefficient was used for correlation analysis; additionally, factors influencing NDI, such as somatization, anxiety, and depression were analyzed by linear regression analysis; $P<0.05$ was considered statistically significant.

Results

Demographic characteristics and somatization scores of FD patients

Herein, 612 patients were diagnosed with FD according to Rome IV criteria. 17.3% (106/612) of patients were identified with anxiety disorders, 13.6% (83/612) of patients had comorbidity of depression, and 7.8% (48/612) of patients were diagnosed with comorbidity of anxiety and depression. Among 471 FD patients without comorbidity of anxiety and depression, 63.5% (299/471) and 36.5% (172/471) of patients were female and male, respectively. The proportions of FD patients' level of education for primary school, middle school, high school, college or above were 22.7% (107/471), 47.3% (223/471), 14.4% (68/471), and 15.5% (73/471), respectively. The patients' mean age was 43.4±10.3 years old (range, 18-67 years old). Moreover, 20.6% (97/471) of patients were diagnosed with EPS, 31.0% (146/471) with PDS, and 48.4% (228/471) with both EPS and PDS. The FD patients' demographic characteristics used for the PHQ-8 and the SSS-8 are shown in Table 1.

Among the scores evaluated by these two scales, a significant difference was found in gender ($P<0.05$). However, there were no significant differences between different ages and levels of educational ($P<0.05$).

Items used for developing the PHQ-8 were selected by the four methods

Using discrete degree method, chest pain, shortness of breath, fainting, palpitation, sexual life pain or other discomfort, numbness/tingling, excessive sweat, heavy hands/foot, a bursts of cold/fever, memory loss/forgetfulness, urinary frequency, urinary pain /dysuria, blurred vision, neck and shoulder pain, and muscle pain were removed since the SD of the items was defined < 0.5.

Using correlation coefficient method, fainting (r=0.090), dysmenorrhea or menstrual other discomfort (r=0.243), excessive sweat (r=0.296), and urinary pain /dysuria (r=0.260) were removed.

According to factor analysis method, the value of KMO value for the initial scale was 0.668, and the value of Bartlett's spherical test was 366.894, P < 0.01, which was appropriate for factor analysis, and indicated that each item had a factor loading of more than 0.4 in its dimension except for headaches and chest pain.

Cronbach's α coefficient method showed that the α coefficient increased after removing fainting and urinary pain /dysuria.

The screened items of the developed PHQ-8 are presented in Table 2, including back pain, pain in arms, legs, or joints, dizziness, fatigue, dry mouth, feeling tired or having low energy, insomnia or other sleep problems, and throat discomfort.

Reliability analysis of the developed PHQ-8 and the SSS-8

Intrinsic reliability analysis

Cronbach's α is a measure of the internal consistency or reliability. The Cronbach's α test is typically utilized to examine the consistency and stability of the questionnaires. Hence, the Cronbach's α was herein applied to ascertain whether the items were reliable in measuring the same dimension. It is generally believed that when the Cronbach's alpha coefficient is greater than 0.7, the reliability is satisfactory [48]. The Cronbach α coefficient of the developed PHQ-8 and the SSS-8 was 0.601 and 0.553, respectively. The correlation coefficient between each item and the total score was 0.426–0.652 and 0.359 –0.573, respectively.

Criterion validity

Criterion validity unveiled that the correlation coefficient between the total score of the PHQ-8 and the SSS-8 and the PHQ-15 was (r=0.739, P=0.000) and (r=0.835, *P*=0.000), respectively. As shown in Table 3, the developed PHQ-8 outperformed the SSS-8.

Structural validity analysis for the developed PHQ-8 and the SSS-8

Exploratory factor analysis: The developed PHQ-8 showed to have values of 0.668 and 366.894, (P<0.01) in KMO and Bartlett's spherical tests; for the SSS-8, the corresponding values were 0.680 and 236.445 (P<0.01), respectively. The exploratory factor analysis was carried out on the scale, and the principal component method was used to maximize the orthogonal rotation through the covariance matrix and the variance, in which the common factor was extracted by using the Kaiser criterion (Eigenvalue > 1). Additionally, 3 common factors of the developed PHQ-8 were extracted, and the cumulative contribution rate was 55.103%. The range of factor loading was 0.482–0.802, which was higher than the minimum standard of structural validity test equal to 0.4 [46,48]; Besides, 3 common factors for the SSS-8 were

extracted, and the cumulative contribution rate was 51.666%. The range of factor loading was 0.353 0.881. All coefficients related to factor loading for PHQ-8 and the SSS-8 are summarized in Tables 4 and 5.

Confirmatory factor analysis: Confirmatory factor analysis model often employs values of chi-squared values (c^2), root mean square residual (RMR), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted GFI (AGFI), comparative fitting index (CFI), Tucker-Lewis index (TLI), normed fit index (NFI), and other indicators were utilized to evaluate the fitting effect of the model. The smaller the value of c^2, and GFI, AGFI, CFI, TLI, NFI > 0.9 indicated that the model fitted well, the closer to the "I", the better; besides, RMR and RMSEA < 0.05 indicated that the model fitted well, the closer to "0" fit, the better. The developed PHQ-8 and the SSS-8 were separately assessed by exploratory factor analysis, and 3 common factors were extracted. Two scales confirmatory factor analysis had a good 3-factor model fit, shown in Table 6.

Correlation analysis of anxiety, depression, somatization, and the DSS for the developed PHQ-8 and the SSS-8

Somatization was evaluated by the developed PHQ-8 and the SSS-8. Correlation analysis showed that anxiety, depression, and somatization were positively correlated with the DSS (Table 7). The correlation coefficient between the DSS and somatization assessed by the SSS-8 was higher than that of the developed PHQ-8.

Linear regression analysis of the effects of anxiety, depression, somatization on the DSS

Somatization, anxiety, and depression were taken as independent variables, and the DSS was taken as a dependent variable, and linear regression analysis was conducted by the backward elimination method. After adjusting for factors, such as gender, age, type of FD, level of education, and employment situation, it was uncovered that depression and somatization were found as factors influencing the DSS (Table 8). The adjusted $R^2$for the PHQ-8 and the SSS-8 were 0.263 and 0.263, respectively (all P<0.001). It also was unveiled that the role of somatization might be more significant than depression. The standardized β for the SSS-8 seemed to be higher than that for the PHQ-8.

Correlation analysis of anxiety, depression, somatization and QoL

Correlation analysis showed that somatization, anxiety and depression were positively correlated with the NDI (Table 9). Compared with the SSS-8, the correlation coefficient between NDI and somatization for the developed PHQ-8 was higher.

Linear regression analysis of the effects of anxiety, depression, somatization on QoL

The NDI for QoL was taken as a dependent variable, and somatization, anxiety and depression were as independent variables. The linear regression analysis was undertaken by backward elimination method. After adjusting for factors, such as gender, age, type of FD, level of education, and employment situation,

somatization, anxiety and depression were noted as factors the influencing QoL (Table 10). The adjusted R^2 for the PHQ-8 and the SSS-8 were 0.224 and 0.236, respectively (all $P<0.001$). Somatization appeared to be more important than anxiety and depression. The standardized β for the PHQ-8 was greater than that for the SSS-8.

Discussion

The FD is the result of the interaction of physiological function and psychosocial factors through brain-gut axis changes [2, 5]. Somatization in psychosocial factors influences health-related QoL after controlling symptoms of anxiety and depression disorders in FD patients [30, 49]. Those factors may lead to the deterioration of symptoms by aggravating anxiety and depression, resulting in repeated medical treatment and economic burden [33]. Somatization symptoms are extensively assessed by the PHQ-15, possessing high reliability and validity not only in general population, but also in patient population [34, 50].

However, assessment of somatization symptoms by the PHQ-15 accompanies with a number of limitations in the study of FD patients. First, the PHQ-15 is not a specific scale for FD patients, which has three items overlapping with gastrointestinal symptoms. Secondly, there is a menstrual problem which is not applicable to menopausal women and may cause differences in gender. Thirdly, due to cultural differences, patients assessed by the PHQ-15 has a poor compliance with questions related to sexual issues. Fourthly, the relative incidence of syncopal items is low [35]. Finally, the majority of patients with somatic symptoms are often visited in a general outpatient clinic without non-psychiatric doctors, which may result in less satisfactory results. Hence, it is highly essential to use a more simple tool to assess FD patients' somatization symptoms and its severity, which is conducive to doctors to present patients more reliable therapeutic advices.

Therefore, the SSS-8 has been used for fast assessment of somatization symptoms and its severity, avoiding differences in gender caused by menstrual abnormalities, sexual life problems caused by cultural differences, and low incidence of syncopal items [38], while it is a non-specific scale for FD patients and overlaps with gastrointestinal symptoms in the clinical application. In addition, the SSS-8 did not include FD patients' typical symptoms, such as throat pain, which may lead to neglect those symptoms by clinicians.

Hence, due to limitations of the SSS-8, in the present study, the PHQ-8 was developed by screening 25 items related to somatization. Gierk et al. [40] used confirmatory factor analysis to analyze the validity of the SSS-8, and their results showed that the 3-factor model outperformed the 1-factor model. Similarly, we, in the current study, used a 3-factor model for confirmatory analysis of the PHQ-8 and the SSS-8. The 3-factor model fitted for the SSS-8 showed to have a superior performance than that of the PHQ-8.

The developed PHQ-8, however, showed to have superiority compared with the SSS-8 for FD patients as follows: Firstly, the PHQ-8 is a specific scale for FD patients; the PHQ-8 includes FD patients' typical symptoms of somatization, e.g. throat pain, which has no overlap with gastrointestinal symptoms.

Secondly, in the PHQ-8, each item is significantly correlated with the total score, reflecting higher reliability of the PHQ-8 than that of the SSS-8. Thirdly, the PHQ-8 may be superior than the SSS-8 in the internal consistency. Fourthly, the PHQ-8 has a higher cumulative contribution rate than the SSS-8 in the exploratory factor analysis. Finally, the PHQ-8 is markedly correlated with NDI compared with the SSS-8, when NDI is used as a classic QoL assessment scale in the criterion validity.

The developed PHQ-8 was further evaluated in order to compare with the SSS-8 for 612 FD patients including anxiety or depression, because previous studies showed that anxiety, depression, and somatization had mutual effects [21, 33]. The results of the present study unveiled that the SSS-8 may play a more significant role in the DSS than the PHQ-8 because of the fact that the SSS-8 overlaps with gastrointestinal symptoms. However, somatization assessed by the PHQ-8 may have a greater influence on QoL than that of the SSS-8 in FD patients.

There were some shortcomings in the present research. Firstly, the patients with FD came from tertiary hospitals. These patients may have severe symptoms, limiting the prevalence of other people with FD. However, whether other FD patients from the community can achieve the same conclusion requires further studies. Secondly, this study mainly analyzed and evaluated specific somatization symptoms of FD patients by the developed PHQ-8, which healthy people and patients with other diseases (e.g., irritable bowel syndrome IBS) were not involved. Thirdly, the PHQ-8 was not tested for retesting reliability for all the cases, thus, the reliability of the scales needs to be further confirmed. Fourthly, similar to the SSS-8, the PHQ-8 was used to assess the severity of somatoform disorders [34]. Finally, data achieved via questionnaires were often abnormally distributed, while those were analyzed similar to normally distributed data as reported in previous large-sample studies [33, 44]. Accordingly, further researches with large sample size are required to improve the rationality of the developed PHQ-8.

In presence of the above-mentioned limitations, the results of the present study showed that the PHQ-8 developed for evaluating somatization and QoL outperformed the SSS-8 not only for FD patients without anxiety and depression, but also for FD patients with anxiety and depression. Somatization may be a more important factor influencing DSS and NDI compared with anxiety and depression, as well as *H. pylori* infection, gastric sensitivity, gastric accommodation, and gastric emptying in FD patients [21, 34]. Somatization was mainly treated by antidepressant drugs, which were often used to treat functional dyspepsia in patients without undergoing the effects of combined prokinetic and proton pump inhibitor therapy [34, 51]. Therefore, evaluating somatization is essential in the study of FD patients. The PHQ-8 may be more helpful to quickly assess somatization in lieu of the SSS-8 in the future FD-based studies.

Conclusions

The PHQ-15 and the SSS-8 have overlap in gastrointestinal symptoms in FD patients, and the SSS-8 was recommended to be a replacement for the PHQ-15 in a short period of time. The developed PHQ-8 without having overlap in gastrointestinal symptoms showed to have satisfactory reliability and validity. Somatization assessed by the developed PHQ-8 may have a greater impact on QoL of FD patients

compared with the SSS-8. Our findings suggested that the developed PHQ-8 may be more effective for evaluating the influences of somatization on QoL of FD patients rather than SSS-8, which may be helpful to further verify the efficacy of the developed PHQ-8 to promptly assess the effects of somatization on FD patients.

Declarations

Ethics declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Affiliated Hospital of North Sichuan Medical College (Nanchong, China). All the patients signed the written informed consent form.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon a reasonable request.

Competing interests

The authors declare that no competing interests exist.

Funding

None.

Authors' contributions

YCQ and YGZ conducted study design, collected and analyzed the data, and revised the manuscript; WX and XT participated in collecting and analyzing the data, and drafted the manuscript; WCY and YY participated in data analysis and interpretation, and edited the manuscript; HGB participated in the study design, analyzed the data, and revised the manuscript. All the authors read and approved the final version of the manuscript.

Acknowledgements

None.

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Abbreviations

FD: functional dyspepsia; SSS-8: Somatic Symptom Scale-8; PHQ-8: Patient Healthy Questionnaire-8; QoL: quality of life; NDI: Nepean Dyspepsia Index; RMR: root mean square residual; RMSEA: root mean square error of approximation; GFI: goodness-of-fit index; AGFI: adjusted goodness-of-fit index; CFI: comparative fit index; TLI: Tucker-Lewis index; NFI: normed fit index; EPS: epigastric pain syndrome; PDS: postprandial distress syndrome; PHQ-15: Patient Healthy Questionnaire-15; PHQ-12: Patient Healthy Questionnaire-12; GAD-7: Generalized Anxiety Disorder-7; PHQ-9: Patient Health Questionnaire-9; DSS: dyspepsia symptom severity.

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Tables

Table 1. Demographic characteristics of 471 FD patients versus scores of two somatization scales (Mean ± SD)

	PHQ-8	*t/F*	*P*-value	SSS-8	*t/F*	*P*-value
Gender		2.484	0.013		3.322	0.001
Male(n=172)	4.32±2.78			4.30±2.29		
Female(n=299)	4.97±2.65			5.04±2.39		
Age (years old)		1.439	0.231		1.987	0.115
18-29(n=45)	3.96±2.49			3.98±2.03		
30-44 (n=201)	4.78±2.61			4.84±2.33		
45-59 (n=211)	4.87±2.85			4.90±2.48		
≥60 (n=14)	4.57±2.62			4.50±2.47		
Level of education		1.669	0.173		2.428	0.065
Primary school (n=107)	5.15±2.96			5.25±2.76		
Junior high school (n=223)	4.46±2.71			4.54±2.24		
High school (n=68)	4.87±2.63			4.96±2.48		
College or above (n=73)	4.82±2.38			4.62±2.03		

Table 2 The PHQ-8 developed by screening 25 items using four methods

Items	Degree of dispersion	Correlation coefficient	Factor analysis	Cronbach's coefficient	α
Back pain	0.679	0.427	0.722	0.746	
Pain in arms, legs, or joints	0.557	0.403	0.673	0.746	
Dysmenorrhea or menstrual other discomfort	0.464(×)	0.243(×)	0.617	0.754(×)	
Headaches	0.577	0.403	0.380(×)	0.746	
Chest pain	0.496(×)	0.395	0.362(×)	0.745	
Shortness of breath	0.497(×)	0.448	0.427	0.742	
Dizziness	0.581	0.490	0.650	0.739	
Fainting	0.112(×)	0.090(×)	0.609	0.755(×)	
Palpitation	0.480(×)	0.386	0.514	0.746	
Sexual pain or other discomfort	0.294(×)	0.313	0.511	0.749	
Feeling tired or having low energy	0.687	0.543	0.731	0.735	
Insomnia or trouble sleeping	0.694	0.378	0.623	0.751	
Numbness/tingling	0.470(×)	0.341	0.731	0.749	
Fatigue	0.628	0.509	0.780	0.738	
Throat discomfort	0.763	0.457	0.434	0.746	
Dry mouth	0.674	0.375	0.636	0.751	
Excessive sweat	0.466(×)	0.296(×)	0.757	0.751	
Hand/foot heavy feeling	0.364(×)	0.322	0.409	0.749	
A burst of cold / fever	0.447(×)	0.464	0.505	0.741	
Memory loss/forgetfulness	0.493(×)	0.415	0.724	0.744	
Urinary frequency	0.449(×)	0.364	0.717	0.747	
Urinary pain/dysuria	0.242(×)	0.260(×)	0.740	0.751	
Blurred vision	0.419(×)	0.309	0.739	0.750	
Neck and shoulder pain	0.487(×)	0.382	0.645	0.746	
Muscle pain	0.374(×)	0.396	0.729	0.745	

Note: × indicated that the item was removed.

Table 3. Correlation analysis between somatization and quality of life of FD patients

Variable		FD (n=471)	PDS (n=146)	EPS (n=97)	Overlap (n=228)
PHQ-8	r	0.309	0.281	0.190	0.360
	P	<0.001	0.001	0.063	<0.001
SSS-8	r	0.281	0.236	0.197	0.317
	P	<0.001	0.004	0.053	<0.001

Table 4. Exploratory factor analysis for the developed PHQ-8

Items	Factor 1	Factor 2	Factor 3
Feeling tired or having low energy	0.802		
Fatigue	0.769		
Insomnia or trouble sleeping	0.525		
Dizziness	0.482		
Back pain		0.797	
Pain in arms, legs, or joints		0.719	
Throat discomfort			0.728
Dry mouth			0.706

Table 5. Exploratory factor analysis for the SSS-8

Items	Factor 1	Factor 2	Factor 3
Back pain	0.713		
Pain in arms, legs, or joints	0.695		
Headaches	0.495		
Chest pain or shortness of breath	0.494		
Insomnia or trouble sleeping		0.806	
Feeling tired or having low energy		0.767	
Stomach or bowel problems			0.881
Dizziness			0.353

Table 6. The results of confirmatory factor analysis of the developed PHQ-8 and the SSS-8

Scale	model	c^2	df	RMR	RMSEA	GFI	AGFI	CFI	TLI	NFI
PHQ-8	3 factors	31.247	17	0.016	0.042	0.984	0.967	0.958	0.931	0.915
SSS-8	3 factors	17.251	17	0.010	0.007	0.991	0.981	0.998	0.997	0.927

Table 7. Correlation analysis of somatization, anxiety, depression and the dyspepsia symptom severity

Variable		FD (n=612)	PDS (n=175)	EPS (n=112)	Overlap (n=325)
Anxiety	R	0.223	0.231	0.147	0.232
	P	<0.001	<0.001	<0.001	<0.001
Depression	R	0.323	0.296	0.322	0.333
	P	<0.001	<0.001	<0.001	<0.001
Somatization PHQ-8	R	0.374	0.396	0.293	0.346
	P	<0.001	<0.001	<0.001	<0.001
Somatization SSS-8	R	0.399	0.395	0.281	0.362
	P	<0.001	<0.001	<0.001	<0.001

Table 8. The effects of somatization, anxiety, and depression on the dyspepsia symptom severity

Variable	Unstandardized β	Standardized β	*t*-value	*P*-value
Depression	0.144	0.176	3.911	<0.001
Somatization PHQ-8	0.287	0.256	6.460	<0.001
Depression	0.154	0.188	4.218	<0.001
Somatization SSS-8	0.206	0.257	6.431	<0.001

Table 9. Correlation analysis of somatization, anxiety, depression and the Nepean Dyspepsia Index

Variable		FD (n=612)	PDS (n=175)	EPS (n=112)	Overlap (n=325)
Anxiety	R	0.327	0.258	0.268	0.367
	P	<0.001	<0.001	<0.001	<0.001
Depression	R	0.354	0.266	0.304	0.394
	P	<0.001	<0.001	<0.001	<0.001
Somatization PHQ-8	R	0.404	0.325	0.309	0.446
	P	<0.001	<0.001	<0.001	<0.001
Somatization SSS-8	R	0.389	0.285	0.345	0.418
	P	<0.001	<0.001	<0.001	<0.001

Table 10. The effects of somatization, anxiety, and depression on the Nepean Dyspepsia Index

Variable	Unstandardized β	Standardized β	*t*-value	*P*-value
Anxiety	0.567	0.163	3.784	<0.001
Depression	0.490	0.136	3.986	0.003
Somatization (PHQ-8)	1.330	0.270	6.638	<0.001
Anxiety	0.541	0.156	3.580	<0.001
Depression	0.557	0.155	3.416	0.001
Somatization(SSS-8)	0.883	0.250	6.311	<0.001

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