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# Reliability and validity of the gastrointestinal symptom rating scale in patients with gastroesophageal reflux disease

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**The objective of this study was to evaluate the reliability and validity of the Gastrointestinal Symptom Rating Scale (GSRS) in US patients with gastroesophageal reflux disease (GERD). Five hundred and sixteen adults with predominant heartburn symptoms of GERD were recruited from gastroenterologist and family physician practices and treated with 6 weeks of 150 mg ranitidine twice daily to identify poorly responsive symptomatic GERD. The GSRS, the Medical Outcomes Study Short Form-36 (SF-36) Health Survey and the Psychological General Well-being (PGWB) scale were administered at baseline and after 6 weeks of treatment. Reported ratings of GERD-related symptoms from physician and patient diaries were measured. The GSRS contains five scales: reflux syndrome, abdominal pain, constipation syndrome, diarrhoea syndrome and indigestion syndrome. The internal consistency reliabilities for the GSRS scales ranged from 0.61 to 0.83 and the intraclass correlation coefficients ranged from 0.42 to 0.60. The GSRS scale scores were correlated with the SF-36 and PGWB scales and with the number and severity of heartburn symptoms. Patients with two or three clinician-rated GERD-related symptoms reported worse GSRS scale scores compared with patients with fewer symptoms ($p < 0.0001$). Statistically significant differences in the mean GSRS scale scores were observed between treatment responders and non-responders ($p < 0.0001$) and patients showing a response to treatment had larger mean changes in their GSRS scales than patients not showing a response to treatment ($p < 0.0001$). The standardized response means ranged from 0.42 to 1.43 for the GSRS scale scores. It was concluded that the GSRS is a brief, fairly comprehensive assessment of common gastrointestinal symptoms. The GSRS has good reliability and construct validity and the GSRS scales discriminate by GERD symptom severity and are responsive to treatment. The GSRS is a useful patient-rated symptom scale for evaluating the outcomes of treatment for GERD.**

*Key words*: GERD; GSRS; validity; reliability.

## Introduction

Health-related quality of life (HRQoL) measures are important for assessing the outcomes of medical treatment. The conceptualization of HRQoL includes the domains of physical, psychological and social functioning and often disease-related symptoms.[1–3] HRQoL assessment is a necessary component of clinical trials that aim to evaluate comprehensively pharmaceutical treatment for chronic diseases, such as gastroesophageal reflux disease (GERD), hypertension, depression and other chronic diseases. HRQoL outcomes are useful in understanding the impact of gastrointestinal symptoms and therapy in duodenal ulcer,[4] inflammatory bowel disease,[5–6] GERD[7–9] (D. A. Revicki, M. Wood and P. Matan, submitted) and chronic gastrointestinal disorders in general[10–13]. Recently, D. A. Revicki, M. Wood and P. Matan (submitted) showed that patients with GERD experience significantly worse HRQoL compared with the US general population. Previous research has also demonstrated that patient HRQoL is correlated with the number and severity of gastrointestinal symptoms.[7,8,11] HRQoL in gastrointestinal disease depends primarily on the patient's subjective

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assessment of relief from the symptoms and on the impact of symptom relief on psychological well-being and other HRQoL domains.[3]

Measures of disease-specific symptoms are available for irritable bowel disease[6,14,15] and GERD,[16] but symptom scales are absent for other gastrointestinal disorders. The Gastrointestinal Symptom Rating Scale (GSRS) contains 15 common gastrointestinal symptoms and requires patients to rate the severity of their symptoms over the past week or 2 weeks.[17,18] A recent study of more than 1,500 patients referred for endoscopy found that the GSRS is reliable and demonstrates the ability to discriminate across different gastrointestinal disorders.[11] However, the GSRS has not been used frequently in clinical trials or observational studies in gastroenterology and primary care practices in the USA. It is therefore uncertain whether the GSRS possesses acceptable psychometric characteristics for applications in clinical studies in the USA.

This paper evaluates the psychometric properties of the GSRS in patients with GERD recruited from gastroenterology and family physician practices in the USA. This stuy examines the internal consistency and stability, construct validity and responsiveness of the GSRS in a sample of 516 patients with GERD enrolled in the first phase of a clinical trial to evaluate treatments for poorly responsive GERD.

## Methods

### Data source

The patient data for the psychometric evaluation of the GSRS were from phase 1 of a multicentre, prospective, double-blind, randomized clinical trial designed to evaluate the impact of omeprazole compared to ranitidine therapy on clinical and HRQoL outcomes in poorly responsive GERD patients. A total of 533 patients were enrolled who were at least 18 years of age and had a history of heartburn for the previous 6 months and moderate to severe heartburn for 4 of the 7 days immediately preceding study entry. Patients with Zollinger – Ellison syndrome; a history of oesophageal stricture, Barret's metaplasia or oesophagoduodenal ulcers, gastrointestinal bleeding in the previous 3 days, use of a proton pump inhibitor within the month prior to the study, use of a histamine-2 receptor antagonist during the 2 weeks prior to study entry or a history of drug or alcohol addiction were excluded from study participation.

Five hundred and sixteen of the 533 (96%) patients had complete GSRS and HRQoL data and were included in the present study. The mean age of the GERD sample was 46 years (SD = 14 years); 42.5% were male and 85.7% were Caucasian. Seventy-four percent of the patients had experienced at least one severe heartburn episode in the week preceding the baseline evaluation.

### Treatment regimen

During phase 1 of the clinical trial, all patients were treated with 150 mg of open-label ranitidine twice a day for 6 consecutive weeks. Gelusil tablets were dispensed for use on an as-needed basis but not to exceed six tablets per day for the relief of heartburn, sour stomach, acid indigestion and symptoms of gas.

### GSRS

The GSRS is a disease-specific instrument, developed, based on reviews of gastrointestinal symptoms and clinical experience, to evaluate common symptoms of gastrointestinal disorders.[17,18] The GSRS contains 15 items, each rated on a seven-point Likert scale from no discomfort to very severe discomfort. Based on a factor analysis, the 15 GSRS items break down into the following five scales: abdominal pain (abdominal pain, hunger pains and nausea); reflux syndrome (heartburn and acid regurgitation), diarrhoea syndrome (diarrhoea, loose stools and urgent need for defecation), indigestion syndrome (borborygmus, abdominal distension, eructation and increased flatus) and constipation syndrome (constipation, hard stools and feeling of incomplete evacuation).[11] The scores are calculated by taking the mean of the items completed within an individual scale, with higher scores indicating greater severity of symptoms. The GSRS in European patient populations has a good internal consistency reliability[11] and acceptable construct validity and responsiveness.[11,18,19] The GSRS can be administered in either self-report or interview format. For this study, we made minor modifications from the original UK English translation to be more comparable with US English language. The modified GSRS was pilot tested in a group of 60 patients with different gastrointestinal disorders from two gastroenterology practices. No problems were encountered with patient understanding or questionnaire administration. The modified GSRS was reliable and the scores correlated with the Psychological General Well-being (PGWB) index.[11]

### Generic health status measures

Health status was assessed using two self-administered questionnaires: the Medical Outcomes Study Short Form-36 (SF-36) Health Survey and the PGWB index. These questionnaires were administered at baseline and at 6 weeks.

The SF-36 is a generic HRQoL instrument that measures functioning and health status. This instrument has 36 questions evaluating physical function, role limitations-physical, bodily pain, vitality, general health perceptions, social functioning, role limitations-emotional and mental health.[21] The SF-36 was designed to evaluate functioning and well-being in primary care patient populations and in patients with chronic conditions. In this study, the internal consistency reliability of the SF-36 scales ranged from 0.74 to 0.90. Physical and mental component summary scales have recently been developed based on SF-36 scale scores.[22] The SF-36 scale and summary scores have good construct validity and have been incorporated into a number of clinical trials and observational studies.[21,22]

The PGWB index is a generic instrument that measures subjective feelings of psychological well-being and distress.[23] It consists of 22 items which measure anxiety, depression, self-control, positive well-being, general health and vitality. Respondents rate each item on a six-point scale. The PGWB index has a reported internal consistency reliability for the total score of 0.94 and a range of 0.72–0.88 for the scales.[23] Dimenas *et al.*[11,18,24] have used the PGWB index extensively in studies of gastrointestinal disorders. It has excellent validity and has been shown to be very sensitive to the occurrence of disease-related symptoms in hypertensive patients.[25]

### Clinical Measures

A symptom severity scale was constructed based on clinician ratings of acid regurgitation, dysphagia and epigastric pain after 6 weeks of therapy. The severity of these symptoms were rated as none, mild, moderate or severe. The symptom severity scale represents an aggregation of ratings of moderate or greater severity on each of the three symptoms. The scores ranged from 0 (no symptoms rated $\geq$ moderate severity) to 3 (all three symptoms rated $\geq$ moderate severity).

The patients completed diaries on a daily basis during the week before the 6 week evaluation. At the end of 6 weeks of ranitidine therapy, the patients were classified as responsive to therapy (responders) or poorly responsive to therapy (non-responders) on the basis of the symptom data recorded in the patient diary for the 7 day period preceding the 6 week evaluation. A responsive patient was defined as having no episode of moderate to severe heartburn in the 7 days prior to the 6 week evaluation. A non-responsive patient was defined as having one or more episodes of moderate to severe heartburn in the 7 days prior to the 6 week evaluation. The total number of heartburn episodes and average severity of heartburn episodes were used to validate the GSRS scale scores.

### Data analysis

The internal consistency reliability of the GSRS was evaluated using Cronbach's $\alpha$.[26] Long-term stability was evaluated using Pearson product moment correlations between the baseline and 6 weeks for the total sample. Intraclass correlation coefficients[27,28] were computed for the non-responsive GERD patients to assess stability.

The construct validity of the GSRS was evaluated through Pearson product moment and Spearman correlations between the GSRS and the SF-36 scales, the PGWB scales and the diary-based heartburn symptoms. The discriminant validity of the GSRS was evaluated using *t*-tests for independent groups to compare the mean GSRS scores of the responders and non-responders. Analysis of variance was used to evaluate the impact of GERD-related symptom severities, as rated by physicians, on the GSRS scale scores. The responsiveness of the GSRS scales to change attributable to ranitidine treatment was evaluated by using analysis of variance to compare the baseline to 6 week change scores of the responders and non-responders. The **c**hange scores were calculated by subtracting the baseline scores from the week 6 scores. Standardized response means were constructed as the mean change in score divided by the standard deviation of patients' changes in scores.[29]

## Results

The baseline mean GSRS and selected generic health status scale scores for the total sample of GERD patients are summarized in Table 1. The physical and mental component summary scores for the GERD patients are lower than the norms for the US general population.[22] The mean PGWB total scores for our sample are comparable to the mean PGWB total scores reported for other GERD patient samples (mean = 98),[24] although they are lower than the US general population.[23]

**Table 1.** Mean baseline GSRS, SF-36 physical component summary and mental component summary, and PGWB index total scores for GERD patients

| | Mean (SD) | |
|---|---|---|
| GSRS | | |
| Reflux syndrome | 3.09 | (0.85) |
| Diarrhoea syndrome | 1.74 | (0.82) |
| Constipation syndrome | 1.75 | (0.81) |
| Abdominal pain | 2.27 | (0.80) |
| Indigestion syndrome | 2.48 | (0.77) |
| SF-36 | | |
| Physical component summary | 46.2 | (9.2) |
| Mental component summary | 49.4 | (10.1) |
| PGWB total | 95.1 | (14.8) |

## Reliability

The internal consistency reliabilities ranged from 0.61 to 0.83 for the five scales of the GSRS (Table 2). The 6 week stability correlations for the total sample ranged from 0.49 to 0.60. The intraclass correlation coefficients for the non-responsive GERD patients ranged from 0.42 to 0.60, suggesting fair to good stability.

## Construct validity

The construct validity of the GSRS was evaluated by examining the correlations between the GSRS and the SF-36 and PGWB scales. There were no substantive differences between the Pearson and Spearman correlations; therefore only the Pearson correlations are reported. Except for the correlations between GSRS reflux syndrome and role function-physical, mental health and role function-emotional, all of the remaining correlations between the SF-36 and GSRS scales were statistically significantly different from zero ($p < 0.0001$). As expected, the SF-36 bodily pain scale was moderately correlated with the diarrhoea syndrome ($r = 0.30$ and $p < 0.0001$), constipation syndrome ($r = 0.29$ and $p < 0.0001$), abdominal pain ($r = 0.44$ and $p < 0.0001$), indigestion syndrome ($r = 0.31$ and $p < 0.0001$), and reflux syndrome ($r = 0.23$ and $p < 0.0001$) scores. The SF-36 mental component summary and physical component summary scores were moderately correlated with the diarrhoea syndrome, constipation syndrome, abdominal pain and indigestion syndrome scores (Table 3). The correlation between the GSRS reflux syndrome score and the mental component summary score was –0.15 ($p < 0.001$) and that of the physical component summary score was –0.14 ($p < 0.002$).

**Table 2.** Reliability and stability of the GSRS scales

| | Cronbach's α | 6 week stability | Intraclass correlation coefficient[a] |
|---|---|---|---|
| Reflux syndrome | 0.61 | 0.49 | 0.42 |
| Diarrhoea syndrome | 0.83 | 0.53 | 0.53 |
| Constipation syndrome | 0.80 | 0.60 | 0.60 |
| Abdominal pain | 0.62 | 0.51 | 0.51 |
| Indigestion syndrome | 0.70 | 0.52 | 0.50 |

[a]Intraclass correlation coefficient calculated for treatment non-responder groups.

The total score on the PGWB scale was significantly correlated with the diarrhoea syndrome ($r = –0.31$ and $p < 0.0001$), constipation syndrome scores ($r = –0.30$ and $p < 0.0001$), abdominal pain ($r = –0.43$ and $p < 0.0001$), indigestion syndrome ($r = –0.34$, and $p < 0.0001$) and reflux syndrome ($r = –0.21$ and $p < 0.0001$) scores. Except for the PGWB positive well-being score, the remaining PGWB scale scores were significantly correlated with the GSRS diarrhoea, constipation, indigestion and abdominal pain scores (Table 3). The reflux syndrome scores were correlated –0.17 with anxiety ($p < 0.0001$), –0.14 with depression ($p < 0.002$), –0.12 with positive well-being ($p < 0.007$), –0.16 with behavioural control ($p < 0.0002$), –0.22 with general health ($p < 0.0001$) and –0.18 with vitality ($p < 0.0001$).

Table 4 summarizes the correlations between the GSRS scales and patient reports of heartburn symptoms from a 7 day diary. The reflux syndrome scores are most strongly correlated with the number of heartburn symptoms ($r = 0.50$ and $p < 0.0001$) and the average severity of the heartburn symptoms ($r = 0.69$ and $p < 0.0001$). The remaining GSRS scales also correlate 0.25–0.37 with the number of heartburn symptoms and correlate 0.31 – 0.48 with the average severity of the heartburn symptoms.

## Discriminant validity

The GSRS scale scores were compared after 6 weeks of treatment between the responders and non-responders (Table 5). Statistically significant differences in the mean scores were observed on all five scales ($p < 0.0001$). The largest mean differences were seen in the reflux syndrome scores ($p < 0.0001$).

**Table 3.** Correlations between GSRS scales, MOS SF-36 scales and PGWB scales

| | GSRS scales | | | | |
|---|---|---|---|---|---|
| | **Diarrhoea syndrome** | **Constipation syndrome** | **Abdominal pain** | **Indigestion syndrome** | **Reflux syndrome** |
| SF-36 scales | | | | | |
| Physical function | –0.19* | –0.24* | –0.19* | –0.14* | –0.11* |
| Role limitations-physical | –0.25* | –0.21* | –0.29* | –0.19* | –0.09 |
| Bodily pain | –0.30* | –0.29* | –0.44* | –0.31* | –0.23* |
| General health | –0.31* | –0.19* | –0.31* | –0.17* | –0.15* |
| Mental health | –0.25* | –0.30* | –0.34* | –0.25* | –0.13 |
| Role limitations-emotional | –0.22* | –0.25* | –0.31* | –0.22* | –0.12 |
| Vitality | –0.31* | –0.20* | –0.42* | –0.26* | –0.19* |
| Social function | –0.29* | –0.23* | –0.37* | –0.29* | –0.17* |
| Mental component summary | –0.25* | –0.24* | –0.37* | –0.26* | –0.15 |
| Physical component summary | –0.26* | –0.20* | –0.28* | –0.17* | –0.14 |
| PGWB scales | | | | | |
| Total | –0.31* | –0.30* | –0.43* | –0.34* | –0.21* |
| Anxiety | –0.25* | –0.29* | –0.40* | –0.32* | –0.17* |
| Depression | –0.23* | –0.29* | –0.31* | –0.25* | –0.14 |
| Positive well-being | –0.12 | –0.09 | –0.15 | –0.12 | –0.12 |
| Behavioural control | –0.18* | –0.26* | –0.29* | –0.25* | –0.16 |
| General health | –0.32* | –0.27* | –0.41* | –0.31* | 0.22* |
| Vitality | –0.32* | –0.23* | –0.40* | –0.27* | –0.18* |

*$p < 0.0001$.

Table 6 summarizes the mean GSRS scale scores by level of symptom severity as rated by physicians. There were statistically significant differences in the mean GSRS scale scores by symptom severity group ($p < 0.0001$). In general, patients with three symptoms reported significantly higher mean GSRS scale scores than patients with only one or no moderate or severe symptoms and patients with two symptoms reported higher GSRS scores than those with no symptoms. For the indigestion and abdominal pain scales, there was a clear ordering of the mean scores by symptom severity group (Table 6).

### Responsiveness

The responsiveness of the GSRS was evaluated by comparing changes in the GSRS scale scores of the treatment responders and those of the treatment non-responders. The treatment responders demonstrated statistically significant greater change scores than the treatment non-responders on all five GSRS scales ($p = 0.042$ to $p < 0.0001$) (Table 5). As expected, the largest differences were in the reflux syndrome ($p < 0.0001$) and indigestion syndrome ($p < 0.0001$) scores. The standardized response mean for the reflux syndrome scores was 1.43. The standardized response means for the other GSRS scale scores ranged from 0.42 to 0.92.

## Discussion

This study evaluated the psychometric characteristics of the GSRS in a sample of patients enrolled in a US clinical trial comparing treatments for poorly responsive GERD. The internal consistency reliabilities of the GSRS scales were consistent with previous reports on the GSRS[11] and are adequate for group comparisons.[28] For example, the reflux syndrome scale had an internal consistency reliability of 0.61, even thought it consists of only two items. The intraclass correlation coefficients for this group of patients over a 6 week period suggest fair to good stability. These estimates of stability are considered as the lower bounds for reliability given the 6 week interval between the assessments and the likelihood that the patients entered in a clinical trial probably gained

**Table 4.** Correlations between GSRS scale scores and patient diary reports of heartburn symptoms

| | GSRS scales | | | | |
|---|---|---|---|---|---|
| | **Reflux syndrome** | **Diarrhoea syndrome** | **Constipation syndrome** | **Abdominal pain** | **Indigestion syndrome** |
| Number of heartburn episodes in 7 day period | 0.50* | 0.25* | 0.26* | 0.34* | 0.37* |
| Average severity of heartburn episodes in 7 day period | 0.69* | 0.31* | 0.32* | 0.48* | 0.48* |

*$p < 0.0001$.

**Table 5.** Mean baseline and 6 week GSRS scale scores and changes scores for treatment responsive and non-responsive GERD patients after 6 weeks of ranitidine therapy

| | **Baseline[a]** | | **6 week follow-up[a]** | | **Baseline to 6 week change[b]** | |
|---|---|---|---|---|---|---|
| | **Responsive mean (SD)** | **Non-responsive mean (SD)** | **Responsive mean (SD)** | **Non-responsive mean (SD)** | **Responsive mean (SD)** | **Non-responsive mean (SD)** |
| *n* | 114 | 345 | 114 | 345 | 114 | 345 |
| Reflux syndrome | 2.79 (0.80) | 3.24 (0.85)*** | 1.52 (0.53) | 2.76 (0.85)*** | –1.23 (0.86) | –0.46 (0.86)*** |
| Diarrhoea syndrome | 1.64 (0.79) | 1.77 (0.84) | 1.31 (0.52) | 1.67 (0.85)*** | –0.25 (0.62) | –0.08 (0.81) |
| Constipation syndrome | 1.72 (0.86) | 1.75 (0.80) | 1.38 (0.53) | 1.65 (0.78)*** | –0.27 (0.60) | –0.08 (0.70)* |
| Abdominal pain | 2.11 (0.72) | 2.33 (0.83)* | 1.49 (0.50) | 2.02 (0.78)*** | –0.58 (0.79) | –0.29 (0.77)** |
| Indigestion syndrome | 2.34 (0.80) | 2.52 (0.76) | 1.61 (0.54) | 2.21 (0.78)*** | –0.67 (0.73) | –0.30 (0.75)**** |

[a]Mean scores between responsive and non-responsive groups compared using *t*-test for independent groups.
[b]Comparison of mean changes between responsive and non–responsive groups using analysis of variance.
*$p < 0.01$, **$p < 0.001$, ***$p < 0.0001$.

some improvements during the study. Ideally, test–retest reliability is measured over a short interval in groups of patients with stable disease.

The abdominal pain scale was most strongly correlated to measures of generic health status and psychological well-being. The largest correlations were between abdominal pain and measures of pain, energy and vitality, social functioning and psychological distress (e.g. depression, anxiety and mental health). This finding may be due to the high prevalence of abdominal pain symptoms in primary care populations[30] and the common and often disabling experience of these symptoms in patients with gastrointestinal disorders. Dimenas *et al.*[24] have also observed associations between abdominal pain and the severity of heartburn.

The US version of the GSRS demonstrated acceptable construct validity and discriminant validity. Patients with more GERD-related symptoms, as rated by physicians, reported greater symptom severity on the GSRS scales. Since this was a GERD patient population, the reflux syndrome scores showed the strongest patterns of mean scores by severity group. There was a clear and consistent pattern of the mean reflux syndrome scores where those patients with more symptoms also had significantly higher mean scores. As with the reflux scores, the abdominal pain and indigestion syndrome scores also demonstrated consistent associations between the mean scores and physician-related symptom severity. These findings are consistent with Swedish studies of the GSRS in GERD and other gastrointestinal diseases[11,24] and demonstrate the validity of the US translation of the GSRS.

The patient diary-reported frequencies and severities of heartburn symptoms were more closely related to the reflux syndrome scores than the other GSRS scales. The indigestion syndrome and abdominal pain scores were moderately correlated with heartburn symptom severity. Dimenas *et al*[24] found evidence that GERD patients had significantly higher GSRS indigestion and abdominal pain scores compared to the general population. The association between GSRS reflux syndrome scores and patient reports of

**Table 6.** Mean (SD) GSRS scale scores by symptom severity groups after 6 weeks of ranitidine therapy

| | Symptom severity group[a] | | | | | |
|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | ***p*-value[b]** | **Group comparisons[c]** |
| *n* | 199 | 159 | 85 | 32 | | |
| Reflux syndrome | 1.90 (0.77) | 2.56 (0.74) | 3.14 (0.85) | 3.45 (0.99) | < 0.0001 | 3>1, 0; 2>1, 0; 1>0 |
| Diarrhoea syndrome | 1.37 (0.58) | 1.61 (0.77) | 1.78 (0.87) | 2.22 (1.19) | < 0.0001 | 3>2, 1, 0; 2>0; 1>0 |
| Constipation syndrome | 1.43 (0.55) | 1.56 (0.70) | 1.75 (0.89) | 2.32 (0.98) | < 0.0001 | 3>2, 1,0; 2>0 |
| Abdominal pain | 1.61 (0.57) | 1.84 (0.68) | 2.31 (0.82) | 2.76 (0.96) | < 0.0001 | 3>2>1>0 |
| Indigestion syndrome | 1.79 (0.62) | 2.08 (0.72) | 2.42 (0.86) | 2.82 (0.80) | < 0.0001 | 3>2>1>0 |

[a]Aggregation of moderate severity ratings by physicians of acid regurgitation, dysphagia and epigastric pain.
[b]Based on analysis of variance model.
[c]$p < 0.05$ for group comparisons, Bonferonni correction for multiple comparisons.

heartburn symptoms based on diary data provides further support for the validity of the reflux syndrome score.

As expected, GERD patients who demonstrated a treatment response after 6 weeks of ranitidine therapy had a significantly lower mean reflux syndrome and other GSRS scale scores at the end-point compared to non-responders. The treatment responders reported larger improvements in the reflux syndrome, indigestion syndrome and the other GSRS scale scores compared to the treatment non-responders. These findings support the clinical responsiveness of the GSRS scale scores in patients with GERD. The treatment responders had changes in reflux syndrome scores that were more than twice the changes observed in the non-responders. The other GSRS scales also demonstrated greater improvements in the responders compared with non-responders, although of less magnitude. Glise *et al.*[19] showed that the GSRS scale scores were responsive to changes in GERD and peptic ulcer disease after treatment.

The GSRS scale scores in our study were comparable to those reported by Dimenas *et al.*[24] for patients with GERD who participated in clinical trials in Sweden and who had negative endoscopic examinations. The mean reflux syndrome scores were 3.1 in the Dimenas *et al.*[24] study compared to 3.1 in our patient sample. The abdominal pain (Dimenas *et* al.[24] study mean = 2.2 and US study mean = 2.3) and indigestion syndrome scores (Dimenas *et al.*[24] study mean = 2.6 and US study mean = 2.5) were also comparable. The mean scores on the constipation and diarrhoea syndrome scales were similar between the two study samples. The minor differences observed are most likely due to clinical differences in the diagnosis and severity of reflux-related symptoms.

The reflux syndrome scores for the two GERD patient samples were almost identical by severity of the heartburn symptoms. The mean reflux syndrome scores for patients with mild heartburn symptoms were 2.5 in both samples. The mean reflux scores for moderate heartburn symptoms were 3.2 in the Dimenas *et al.*[24] study and 3.1 in our study. For severe heartburn, mean the reflux syndrome scores were 3.7 and 3.5, respectively, for the Dimenas *et al.*[24] study and the US study. These findings support the construct validity of the US translation of the GSRS.

The GSRS is a brief and comprehensive measure of 15 common gastrointestinal symptoms which can be completed by most patients in approximately 5 min. The US version of the GSRS has acceptable reliability and this study provides evidence supporting the construct and discriminant validity of the GSRS in patients with GERD. More importantly for clinical trials of medical treatment for GERD and other gastrointestinal disorders, this study demonstrates the responsiveness of the GSRS scales. However, additional validation studies may be necessary before the GSRS is used in clinical studies for gastrointestinal diseases other than GERD. The findings of this study indicate that the GSRS may be useful, combined with generic or disease-specific health status assessments, in evaluating the impact of different treatments for GERD on patient HRQoL.

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## Appendix: GSRS response scale and items

### Response scale

(1) No discomfort at all.
(2) Slight discomfort.
(3) Mild discomfort.
(4) Moderate discomfort.
(5) Moderately severe discomfort.
(6) Severe discomfort.
(7) Very severe discomfort.

### GSRS items

(1) Have you been bothered by stomach ache or pain during the past week? (Stomach ache refers to all kinds of aches or pains in your stomach or belly.)
(2) Have you been bothered by heartburn during the past week? (By heartburn we mean a burning pain or discomfort behind the breastbone in your chest.)
(3) Have you been bothered by acid reflux during the past week? (By acid reflux we mean regurgitation or flow of sour or bitter fluid into your mouth.)
(4) Have you been bothered by hunger pains in the stomach or belly during the past week? (This hollow feeling in the stomach is associated with the need to eat between meals.)
(5) Have you been bothered by nausea during the past week? (By nausea we mean a feeling of wanting to be sick.)
(6) Have you been bothered by rumbling in your stomach or belly during the past week? (Rumbling refers to vibrations or noise in the stomach.)
(7) Has your stomach felt bloated during the past week? (Feeling bloated refers to swelling in the stomach or belly.)
(8) Have you been bothered by burping during the past week? (Burping refers to bringing up air or gas through the mouth.)
(9) Have you been bothered by passing gas or flatus during the past week? (Passing gas or flatus refers to the release of air or gas from the bowel.)
(10) Have you been bothered by constipation during the past week? (Constipation refers to a reduced ability to empty the bowels.)
(11) Have you been bothered by diarrhoea during the past week? (Diarrhoea refers to frequent loose or watery stools.)
(12) Have you ever been bothered by loose stools during the past week? (If your stools have been alternately hard and loose, this question only refers to the extent you have been bothered by the stools being loose.)
(13) Have you been bothered by hard stools during the past week? (If your stools have been alternately hard and loose, this question only refers to the extent you have been bothered by the stools being hard.)
(14) Have you been bothered by an urgent need to have a bowel movement during the past week? (This urgent need to open your bowels makes you rush to the toilet.)
(15) When going to the toilet during the past week, have you had the feeling of not completely emptying your bowels? (The feeling that after finishing a bowel movement, there is still more stool that needs to be passed.)