

## The Visceral Sensitivity Index: development and validation of a gastrointestinal symptom-specific anxiety scale

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### SUMMARY

**Background:** Anxiety related to gastrointestinal sensations, symptoms or the contexts in which these may occur is thought to play a significant role in the pathophysiology as well as in the health outcomes of patients with irritable bowel syndrome.

**Aim:** To develop a valid and reliable psychometric instrument that measures gastrointestinal symptom-specific anxiety.

**Methods:** External and internal expert panels as well as a patient focus group evaluated a large pool of potential item stems gathered from the psychological and gastrointestinal literature. Potential scale items were then administered to 96 patients diagnosed with

irritable bowel syndrome along with a set of validating questionnaires. Final item selection was based upon rigorous empirical criteria and the psychometric properties of the final scale were examined.

**Results:** A final unidimensional 15-item scale, the Visceral Sensitivity Index, demonstrated excellent reliability as well as good content, convergent, divergent and predictive validity.

**Conclusions:** The findings suggest that the Visceral Sensitivity Index is a reliable, valid measure of gastrointestinal symptom-specific anxiety that may be useful for clinical assessment, treatment outcome studies, and mechanistic studies of the role of symptom-related anxiety in patients with irritable bowel syndrome.

### INTRODUCTION

Irritable bowel syndrome (IBS) is characterized by chronic abdominal pain or discomfort associated with altered bowel habits. It is the most common of the functional gastrointestinal (GI) disorders (10–15% prevalence)<sup>1</sup> and has an impact on disease-related quality of life (QoL) comparable with that of depression and chronic renal failure.<sup>2</sup> Converging clinical, epidemiological and experimental evidence is consistent with a pathophysio-

logical model of IBS that is multifactorial and includes a prominent role for altered central stress responses. This evidence includes the association of IBS symptom exacerbations with certain stressful<sup>3–5</sup> or traumatic<sup>6</sup> life events, frequently reported comorbidity with anxiety disorders, in particular panic disorder and post-traumatic stress disorder,<sup>7</sup> and efficacy of pharmacological and non-pharmacological treatments targeted at the stress circuitry of the central nervous system (CNS).<sup>8, 9</sup>

While peripheral changes in the gut may contribute to overall IBS symptoms in some patients, an altered sensitivity or responsiveness of the emotional motor system (EMS) has been proposed to play an important role in the mediation of autonomic and neuroendocrine

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responses, as well as pain modulation in response to stressful life events.<sup>10</sup> It has previously been suggested that GI symptom-specific anxiety (GSA) may be an important endogenous stressor perpetuating IBS symptoms, even in the absence of external stressors.<sup>11</sup> Similar models of symptom-related anxiety have been shown to play an important role in symptom maintenance and treatment response in other syndromes including chronic pain and panic disorder.<sup>12–14</sup> Most importantly, pathological anxiety directed towards bodily sensations may be present even in patients who do not meet DSM-IV criteria for anxiety disorders.<sup>15, 16</sup> Thus, while IBS patients generally are found to have psychiatric comorbidity in the form of anxiety disorders of up to 40%,<sup>9</sup> a much larger number may show GSA, making the overall prevalence of all types of anxiety in these patients much higher.

In addition to playing a possible role in the pathophysiology of IBS, GSA may play a role in the unexpected severe impairment of disease-related QoL reported by these patients.<sup>2, 17</sup> A recent analysis of specific factors contributing to the QoL impairment in IBS patients found worries about symptoms to be a highly significant predictor of QoL impairment.<sup>17</sup>

Finally, symptom-related anxiety may respond particularly well to therapies such as anxiolytics, 5-HT<sub>3</sub> receptor antagonists, and other centrally targeted compounds such as corticotropin-releasing factor receptor and neurokinin-1 receptor antagonists, as well as various cognitive behavioural therapies. A reduction of this anxiety may play an important role in improving global end-points commonly used in IBS trials, and these global end-points, as well as QoL measures may be greatly influenced by a reduction in symptom-related anxiety. In the current study, a measure of GSA is developed and support for the psychometric properties of this instrument is provided.

## MATERIALS AND METHODS

In the following section, the specific steps taken to develop the rationale and items for the new scale are presented and the methods for the validation study are described.

### *Construct definition*

The GSA was operationalized based on previous conceptualizations of anxiety sensitivity (AS)<sup>18</sup> and

biobehavioural models as applied to IBS.<sup>9</sup> Specifically, the GSA construct was thought to comprise five dimensions of GI-related cognitions and behaviours:

- 1 **Worry:** obsessive, negative, catastrophic thoughts, either learned or innate, reflecting a negative, future-oriented perspective on GI symptoms and their impact.
- 2 **Fear:** learned responses to previously innocuous physical sensation(s) that have been paired with a painful or aversive stimulus; often unassociated with feelings of anxiety.
- 3 **Vigilance:** an increased awareness of, attention to, and increased perceived relevance of GI-specific sensations resulting in a decreased ability to attend to other internal or external stimuli.
- 4 **Sensitivity:** heightened perception of GI-specific sensations and symptoms under a variety of conditions including eating and stress.
- 5 **Avoidance:** increased safety behaviours, rituals, and seeking reassurance to GI-specific sensations.

As triggers for these behaviours and cognitions may be interoceptive (e.g. experience of GI sensations) or contextual (e.g. environmental cues related to GI sensations), item generation was based on considerations regarding stimulus origin as well as affective, cognitive, or behaviour manifestations of the dimensions.

### *Item generation and refinement*

Validated and widely used instruments in the psychological and IBS literature (e.g. Cognitive Scale-Functional Bowel Disorders,<sup>19</sup> Pain Anxiety Symptoms Scale,<sup>20</sup> IBS – QoL<sup>21</sup>) were reviewed for item structure and content thought to be reflective of the dimensions described above. In most cases, the reviewed instruments contained items that were intended to measure a general construct (e.g. trait anxiety) but were not context-specific (i.e. anxieties pertaining to GI sensations or experiences). In these instances, the stem of appropriate items were selected and modified to increase relevance. In some instances, selected items thought to be extremely relevant to the current development of the Visceral Sensitivity Index (VSI) were found as part of larger multidimensional instruments on QoL. Additional sample items were recommended based on the clinical observations of the authors. Items were constructed as questions or statements that could be presented in a self-report format. The resulting 86 sample items were presented to panels of external and internal experts in

IBS as well as a focus group of patients with IBS to address content and face validity issues.

*External panel.* Seven physicians (QA, CB, DD, RF, TL, MS and DW) and two psychologist practitioners/researchers (MC, MH, see Acknowledgements) were asked, via mail, to assist in the evaluation of the items. After being provided with a theoretical rationale for the development effort, the operational definitions of the measurement domains, the sample of items, a set of instructions, and a score sheet, the panellists evaluated each item on the basis of (i) its 'relevance' to the concept of GSA as portrayed in the definitions provided, (ii) its 'conciseness', in terms of its ability to capture and adequately present to patients the focal thought of the statement as succinctly as possible, and (iii) its 'clarity', vis-à-vis its level of understanding for the typical patient with IBS that they saw in their research and/or practice. A 5-point ordinal scale (5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor) was used for each rating and panellists provided an explanation of why and what suggestions they might make to improve the item receiving a rating of poor or very poor. Finally, they were asked to contribute additional items where they thought it would be relevant.

*Internal panel.* A second panel comprised of three of the authors (EM, BN and LC) was brought together and replicated the activities of the external panel. These panellists were also asked to assess the items with regard to the perceived dimension that the item stem was intending to cover. Results from both panels were tabulated and used in the final selection process as described below.

*Patient focus group.* A 2.5-h focus group, moderated by one of the authors (RB) was convened to review the items and address eventual questionnaire format. Eleven participants (ages 22–63) meeting Rome II diagnostic criteria<sup>22</sup> for IBS were recruited by advertisement and gave their reactions to selected items and formats. Consensus of the focus group was that items were best understood if item stems were formatted as statements (e.g. I always try to relieve my bowels before I leave the house in the morning), and the response alternatives were given as ordinal categories from 'strongly agree' to 'strongly disagree'. Based on the focus group results and comments from the expert panels, 90 potential items were generated (i.e. four

additional items were added based on comments made by the panellists). Each item was scored on a 6-point Likert Scale (0 = strongly disagree to 5 = strongly agree). The responses to negatively worded items were reverse scored so that a higher score for each item indicated greater GSA.

#### *Validation study methods*

*Participants.* A total of 100 patients with a documented history of IBS were recruited via advertisement. Patients were mailed a questionnaire battery (see below) and instructions. A nurse followed up with late responders.

*Measures.* In order to assess concurrent and predictive validity for the candidate GSA items, as well as degree of socially desirable responding, participants were administered the 90 GSA items, a bowel symptom questionnaire (BSQ), which includes multiple items regarding symptom severity, quality, and bowel habit information<sup>23</sup> and the Social Desirability Response Set (SDRS).<sup>24</sup> In addition, two well-known measures of anxiety, the Hospital Anxiety and Depression Scale (HAD)<sup>25</sup> and Anxiety Sensitivity Index (ASI),<sup>26</sup> were administered.

The HAD is a self-assessment mood scale specifically designed for use in non-psychiatric settings.<sup>25</sup> It is a well-validated brief inventory for assessment of symptoms of anxiety and depression. The HAD is one of the most widely used psychological symptom questionnaires to document clinical symptoms of state anxiety, depression and somatization.

The ASI<sup>26</sup> is the most widely used self-report measure of AS, the tendency to respond fearfully to the bodily sensations of anxiety rather than a predisposition to respond anxiously to a wide range of external stressors.<sup>18</sup> The ASI is a well-validated multidimensional instrument assessing panic-specific somatic sensations (i.e. heart palpitations), cognitive dyscontrol (i.e. inability to concentrate), and fear of publicly observable dysfunction (e.g. sweating).<sup>27</sup> Conceptualized as a stable personality trait, AS has been conceptually and empirically distinguished from trait anxiety.<sup>18</sup>

#### *Statistical analysis*

Item means and discrimination indices were calculated as were the items' correlation with symptom severity (as measured from the BSQ) and general anxiety (as

measured by the HAD) and the items ratings from the expert panellists. Item retention for the final scale was guided by the following criteria:

- 1 Acceptable item content and face validity: two of three internal panellists rated item relevance as at least very good ( $\geq 4$ ) and agreed upon the item's dimension (e.g. worry, avoidance).
- 2 Sufficient variation: item did not demonstrate distributional floor or ceiling effects (i.e. a mean difficulty  $< 1$  or  $> 3$ ).
- 3 Maximize internal consistency: only items with a moderate correlation ( $\geq 0.45$ ) with the total scale were retained.
- 4 Optimize eventual predictive and concurrent validity: items correlating with symptom severity but evidencing only a moderate relationship with general state anxiety were included (so as not to exhibit excessive convergent validity with this construct).

Factor analysis was used to assess construct internal consistency, reliability and validity of the final selected scale items. Specifically, principal components analysis with varimax rotation was applied to determine the maximum number and nature of the factors comprising of the final scale. Reliability of the final scale was assessed using Cronbach's  $\alpha$  and the mean inter-item correlation, an indicator of item homogeneity in a scale. Validity of the final scale was examined using bivariate correlations and linear regression. In addition, path analysis was used to determine the potential mediating effect of GSA. The significance of mediation was evaluated using the empirical sampling distribution of the product of the coefficients (the estimate of the intervening variable or the indirect effect,  $\alpha\beta$ ) divided by the standard error of the indirect effect,  $\sigma_{\alpha\beta}$ .<sup>28</sup> Similar to significance testing using the standard normal distribution,  $z' = \alpha\beta/\sigma_{\alpha\beta}$  is calculated and tested against the critical value from the empirical sampling distribution of the product of coefficients ( $H_0: \alpha\beta/\sigma_{\alpha\beta} = 0$ ). The empirical critical value at  $\alpha = 0.05$  is 0.97. This test is considered the most powerful method for testing intervening effects.<sup>28</sup> In addition, 95% confidence intervals for the indirect effects were calculated based upon normal distribution theory.

## RESULTS

A total of 96 patients (75 female, 21 male), ranging in age from 19 to 79 years ( $49.4 \pm 13.6$ , mean  $\pm$  s.d.),

completed questionnaires. On average, patients reported an initial IBS diagnosis at age  $39 \pm 15.2$  and reported a mean IBS duration of  $11.4 \pm 10.4$  years. Table 1 contains a more detailed description of the sample.

### Final item selection

After meeting the retention criteria, items were assessed on the basis of content overlap (i.e. when items had redundant content one was dropped) and domain coverage, to yield the final item set of 15-items (see Table 2). The final 15-items were subjected to factor analysis to assess construct internal consistency, reliability and validity. One main factor accounted for 51% of the variance. A minor factor (items 2, 6, 7 and 10) accounted for an additional 8% of the total variance. However, only items 7 and 10 loaded uniquely on this factor rendering interpretation untenable. Forcing a single factor solution resulted in loadings of 0.47–0.81 for the 15-items and supported a unidimensional measure. Given this outcome, the entire 15-item scale was labelled the VSI and was evaluated for reliability and validity as a single scale based on the sum of the individual item scores.

Table 1. Characteristics of the patient sample\*

Rome II diagnosis	85
Usual symptom intensity	
Mild	1.1
Moderate	40
Severe	40
Very severe	17.4
Moderate-to-severe IBS (days per month)	
$\leq 1$	16.7
2–3	33.4
4–5	24
6–7	26
Irregular bowel habit	
>75% hard, lumpy stool	18.3
>75% loose, watery stool	46.2
Alternating bowel habit	35.5
IBS symptoms	
Bloating	98
Distension	76
Fullness in rectum	66
Urgency	74
Nausea	36
Belly pain	85
Altered bowel habits	88

\* Values are percentages of the sample ( $N = 96$ ).  
IBS, irritable bowel syndrome.

Table 2. Symptom content of the Visceral Sensitivity Index items\*

Symptoms	Factor loadings	Item-total correlations
Believe eating causes bloating and distension in the belly	0.58	0.53
Experience anxiety going to a new restaurant	0.66	0.62
Frequent worry about abdominal problems	0.81	0.77
Focus on abdominal discomfort interferes with enjoyment	0.79	0.74
Fear of lacking the ability to have a normal bowel movement	0.70	0.65
Avoid new foods due to fear of developing abdominal symptoms	0.60	0.55
Believe eating causes discomfort	0.69	0.64
Abdominal symptoms lead to worry and anxiety	0.79	0.74
Searching for a bathroom is a priority in new environment	0.68	0.62
Vigilant to feelings in belly	0.68	0.66
Believe pain or discomfort in abdomen indicates serious illness	0.54	0.49
Upon awakening, worries about possible abdominal discomfort during the day	0.80	0.76
Experiences abdominal discomfort as frightening	0.81	0.77
Believe symptoms are experienced during stress	0.72	0.66
Vigilance towards bowels	0.71	0.77

\* Accounts for 51% total variance.

### Reliability

The VSI demonstrated a high level of internal consistency. Cronbach's  $\alpha$  was estimated at 0.93 and the mean inter-item correlation of the VSI was 0.47 (further supporting a unidimensional scale). Table 2 contains the item-total correlations which ranged from 0.49 to 0.77. Additionally, SDRS scores were not correlated with VSI scores,  $r(95) = -0.02$ , ns, suggesting that participant responses did not appear to be influenced by a desire to present in a favourable light.

### Validity

Table 3 contains the mean scores and bivariate correlations between the VSI, HAD anxiety subscale, ASI, and current IBS symptom severity (past week). Scores on the VSI, HAD anxiety subscale, and ASI as well as

Table 3. Bivariate correlations and descriptive statistics for the anxiety and symptom measures\*

	VSI	HAD	ASI	Mean	s.d.
VSI				36.5	18.5
HAD anxiety	0.73			8.1	4.4
ASI	0.66	0.68		20.9	13.3
Symptom severity	0.49	0.42	0.23	10.9	4.6

\* ASI, Anxiety Sensitivity Index; HAD, Anxiety Subscale of the Hospital Anxiety and Depression Scale; symptom severity, IBS symptom severity in the past week; VSI, Visceral Sensitivity Index; IBS, irritable bowel syndrome.

symptom severity were not correlated with age, sex, predominant bowel habit, or age of first diagnosis. Duration of IBS evidenced a small negative correlation with VSI scores,  $r(91) = -0.22$ ,  $P < 0.05$ , suggesting that higher GSA was associated with shorter duration of IBS symptoms. However, the duration variable was positively skewed and the significant negative correlation was not robust to logarithm transformation,  $r(91) = -0.19$ , ns. The relationship between ASI and duration of illness demonstrated similar results.

To examine the relationship between the VSI and severity of IBS symptoms, symptom severity in the past week was regressed simultaneously onto the ASI, HAD, and the VSI. Results indicated that the VSI total score was the strongest independent predictor (of the three anxiety scales) of current IBS symptom severity, accounting for 24% of the variance (adjusted  $R^2$ ) in symptom severity scores,  $\beta_0 = 6.4$  (95% CI: 4.5–8.2),  $\beta_{\text{VSI}} = 0.12$  (0.08–0.17),  $F(1, 94) = 30.4$ ,  $P < 0.001$ . For example, for every 10-point decrease on the VSI a 1.2-point decrease on the 20-point symptom scale is anticipated. After controlling for VSI score neither the ASI or HAD measure explained a significant amount of the variance remaining in symptom severity demonstrating that the VSI is the key predictor of symptoms among these anxiety measures.

Path analysis was applied to examine a potential mediating effect for GSA, see Figure 1. The impact of the ASI on symptom severity through the mediator, GSA, was significant,  $\alpha\beta = 0.14$  (95% CI: 0.08–0.20). The test for

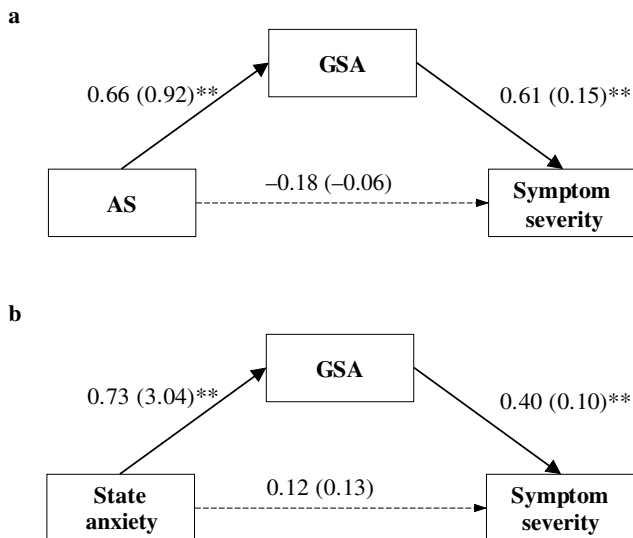


Figure 1. Path diagrams for the intervening variable model. Unstandardized path coefficients are denoted in parentheses. AS, anxiety sensitivity as measured by the Anxiety Sensitivity Index; GSA, gastrointestinal (GI) symptom-specific anxiety as measured by the Visceral Sensitivity Index; HAD, state anxiety as measured by the Anxiety Subscale of the Hospital Anxiety and Depression Scale; symptom severity, irritable bowel syndrome (IBS) symptom severity in the past week. \*\* $P < 0.01$ .

intervening effects indicated significant mediating effects for GSA,  $z' = 4.03$  (95% critical value = 0.97). As can be seen in Figure 1 (Model a), the direct effect of ASI on symptom severity controlling for GSA was not significant,  $c' = -0.06$  (-0.14–0.02). Despite the negative coefficient for the direct effect estimate, neither examination of the confidence intervals nor significance testing indicated evidence of significant suppression effects.

Referring to Figure 1 (Model b), the impact of state anxiety, as measured by the HAD, on symptom severity through the mediator, GSA was significant,  $\alpha\beta = 0.31$  (0.11–0.51). Again, the test for intervening effects indicated that mediating effect for GSA was statistically significant,  $z' = 3.02$  and accounted for 70% of the effect of state anxiety on symptom severity. The direct effect of state anxiety was not statistically significant,  $c' = 0.13$  (-0.14 to 0.39).

Although, the results suggested that the effect of ASI and the effects of state anxiety on symptom severity were completely mediated by GSA, a sample size of 96 was inadequate to detect small effects (i.e.  $ES_r = 0.20$ ). Arguably, an effect contributing 4% or less to the variance in symptom severity may not be clinically relevant.

## DISCUSSION

In the current study, we report the development and validation of a novel instrument for the assessment of GSA. We describe a unidimensional 15-item scale, the VSI, which demonstrates excellent reliability as well as good content, convergent, divergent and predictive validity. There is growing evidence that psychological factors including certain forms of stress are at least partially responsible for maintenance and exacerbation of IBS symptoms. In addition, IBS sufferers, especially those who seek medical attention, have increased levels of affective symptoms, in particular anxiety.<sup>4, 9, 29</sup> However, the majority of IBS sufferers do not reach criteria for an affective disorder and many report normal levels of anxiety on standardized scales. We have hypothesized that GSA and not general anxiety (or depression) may be the best marker of the characteristic cognitive and affective processes in IBS. The VSI is a readily administered 15-item self-report questionnaire designed to measure GSA in IBS including the unique aspects of fear, anxiety and hypervigilance that can accompany misappraisals of GI-specific sensations and discomfort. Empirical validation in 96 patients with moderate to very severe IBS supported a unidimensional scale and strong internal reliability. Face validity was supported by patient focus group and expert opinion endorsing the relevance of items to IBS and the concept of GSA. The VSI was shown to have high levels of convergent validity with other anxiety measures including the HAD anxiety subscale and the ASI. The scale was not influenced by social desirability, age, sex or duration of illness. In addition, it is not influenced by predominant bowel habit.

Supporting the predictive validity of the VSI, the regression analysis indicated a significant relationship with IBS symptom severity even after controlling for the other anxiety measures. While state anxiety assessed by the HAD and AS measured by the ASI were associated with IBS symptom severity, the path analyses indicated it is most parsimonious to view these relationships as mediated through GSA. Similar findings reported in studies of chronic somatic pain suggest that symptom-specific anxiety measures have greater utility for understanding symptom severity than more general measures of AS.<sup>14, 30, 31</sup> The results support a multifactorial model in which there are both general and specific mechanisms of AS.<sup>32</sup> In this model, trait anxiety or neuroticism represents a general mechanism (or

higher order factor) which can predispose an individual to develop symptom-specific anxiety (and accompanying hypersensitivity) such as that measured by the VSI. A variety of physiological or psychosocial factors including trauma, modelling, and acute illness may be important in the development of symptom-specific anxiety in vulnerable individuals.<sup>33, 34</sup> Although related, each of these mechanisms may have their own underlying central circuitry. For example, providing preliminary support for a GI-specific domain of AS, Verne *et al.*<sup>35</sup> reported IBS patients when compared with controls rated much higher fear and anxiety to rectal but not cutaneous pain and this was associated with greater prefrontal cortex activity in IBS patients.

#### *Proposed use for the VSI*

Some recent models of functional GI disorders have proposed that CNS networks such as the EMS play a key role in the modulation of perceptual responses to visceral sensations and GI motility, hypothalamic-pituitary-adrenal axis dysregulation, and possibly as a consequence, immune modulation.<sup>8</sup> GSA may be a sensitive marker for the mental processes associated with activation of the EMS and therefore the VSI could be an important tool in mechanistic investigations in IBS. Based on this model, we propose several specific hypotheses regarding the role of GSA in IBS and related functional GI disorders that may be tested directly using the VSI.

- 1 The high comorbidity of IBS with other functional GI disorders has been hypothesized to result from shared gut-related mechanisms, such as dysmotility, or immune activation.<sup>29</sup> Alternatively, psychological factors such as somatization or stress responsiveness may explain this high comorbidity, and SA might be a key construct in this model.<sup>9, 29</sup> For example, this model predicts that patients with non-functional GI disorders (inflammatory bowel disease, cancer) will score relatively low on the VSI despite significant symptom severity while patients with other functional GI disorders such as functional dyspepsia or non-cardiac chest pain and especially patients with multiple disorders will score high as a result of generalized anxiety about of GI sensations.
- 2 It is hypothesized that IBS symptoms are influenced by both external stressors such as major life events<sup>9</sup> and internal stressors including conditioned and

unconditioned over-responsiveness to GI-specific sensations. The importance of internal stressors in symptom maintenance and exacerbation has not been directly tested as a result of lack of instrumentation. However, studies using both measures of life stress and the VSI may help to determine the relative importance of these two factors in IBS symptoms and QoL.

- 3 We would expect that VSI scores would be related to perceptual responses to experimental GI-specific stimuli supporting the hypothesis that GSA may lead to increased perception of GI-specific stimuli and symptoms through facilitation of pain transmission.
- 4 A variety of treatment modalities proposed for IBS may have a direct impact on GSA including cognitive and educational interventions,<sup>36</sup> and certain centrally targeted medications. Even the global effectiveness of more peripherally acting interventions may depend in a significant way on their ability to change the pattern of cognitive and conditioned responses to GI-specific sensations. The VSI may therefore be an important tool for studying the mechanism of treatment change in a variety of circumstances and ultimately for matching patient characteristics to appropriate interventions.

The current results indicate the VSI should have significant utility as a brief, valid measure of GSA in IBS. Further, empirical work to support the initial reliability and validity should include replication in other IBS patient samples, known validity studies examining healthy individuals and other patient groups with functional and non-functional GI symptoms, convergent/divergent validity studies with other measures thought to have important explanatory roles in IBS (e.g. measures of negative affect and abuse), and assessment of sensitivity to treatment outcome/change.

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APPENDIX 1. VISCERAL SENSITIVITY INDEX<sup>1</sup>*Instructions*

Below are statements that describe how some people respond to symptoms or discomfort in their belly or lower abdomen. These may include pain, diarrhoea,

constipation, bloating or sense of urgency. Please answer 'how strongly you agree or disagree' with each of these statements, AS THEY RELATE TO YOU. Answer all of the statements as honestly and thoughtfully as you can.

Item	Strongly agree	Moderately agree	Mildly agree	Mildly disagree	Moderately disagree	Strongly disagree
1. I worry that whenever I eat during the day, bloating and distension in my belly will get worse	1	2	3	4	5	6
2. I get anxious when I go to a new restaurant	1	2	3	4	5	6
3. I often worry about problems in my belly	1	2	3	4	5	6
4. I have a difficult time enjoying myself because I cannot get my mind off of discomfort in my belly	1	2	3	4	5	6
5. I often fear that I won't be able to have a normal bowel movement	1	2	3	4	5	6
6. Because of fear of developing abdominal discomfort, I seldom try new foods	1	2	3	4	5	6
7. No matter what I eat, I will probably feel uncomfortable	1	2	3	4	5	6
8. As soon as I feel abdominal discomfort I begin to worry and feel anxious	1	2	3	4	5	6
9. When I enter a place I haven't been before, one of the first things I do is to look for a bathroom	1	2	3	4	5	6
10. I am constantly aware of the feelings I have in my belly	1	2	3	4	5	6
11. I often feel discomfort in my belly could be a sign of a serious illness	1	2	3	4	5	6
12. As soon as I awake, I worry that I will have discomfort in my belly during the day	1	2	3	4	5	6
13. When I feel discomfort in my belly, it frightens me	1	2	3	4	5	6
14. In stressful situations, my belly bothers me a lot	1	2	3	4	5	6
15. I constantly think about what is happening inside my belly	1	2	3	4	5	6

<sup>1</sup> In order to increase utility, several of the VSI items were slightly modified subsequent to the reliability analysis to facilitate use with non-IBS populations. This primarily involved changing the word 'symptoms' to reflect specific GI sensations. Examination of this version in a new sample of 27 IBS patients indicates similar internal scale properties ( $\alpha = 0.94$ , average, item scale correlations all  $>0.50$ ) and this is the version that is recommended for use in future studies.