Daily Stress and Gastrointestinal Symptoms in Women With Irritable Bowel Syndrome

Vicky L. Hertig ▪ Kevin C. Cain ▪ Monica E. Jarrett ▪ Robert L. Burr ▪ Margaret M. Heitkemper

Background: Stress has been implicated as contributing to the initiation and exacerbation of bowel and discomfort symptoms in patients with irritable bowel syndrome (IBS).

Objective: To examine the relationships of daily self-reported stress to gastrointestinal (GI) and psychological distress symptoms both across women and within women in a comparison group of women without IBS and among subgroups of women with IBS.

Methods: Women with IBS (n = 181; age = 18–49 years) who were divided into subgroups based on bowel pattern (constipation, n = 52; diarrhea, n = 67; alternating, n = 62) were compared to a group of women without IBS (n = 48). Self-report stress measures; abdominal (abdominal pain, bloating, and intestinal gas), bowel pattern (constipation, diarrhea), and intestinal gas; and psychological (anxiety and depression) distress symptoms were obtained daily over 1 month. Across-women and within-woman analyses were used.

Results: There were significant across-women correlations among mean daily stress, psychological distress, and GI symptoms in the total IBS group and the IBS bowel pattern subgroups. The across-women relationships between daily stress and GI symptoms were diminished when anxiety and depression were controlled in the analyses. Within-woman analyses showed little evidence of relationship between day-to-day variations in stress and day-to-day variations in GI symptoms; however, stress was strongly related to anxiety and depression.

Discussion: Gastrointestinal symptom distress is associated with self-reported stress in women with IBS. Psychological distress moderates the effects of stress on GI symptoms. The IBS treatment protocols that incorporate strategies that decrease stress and psychological distress are likely to reduce GI symptoms.

Key Words: irritable bowel syndrome • psychological distress • stress • women

In Western, industrialized societies, irritable bowel syndrome (IBS) is one of the most common functional gastrointestinal (GI) disorders. It is characterized by symptoms of abdominal discomfort or pain that are associated with disordered defecation, a change in bowel habit, or both (Drossman, Corazziari, Talley, Thompson, & Whitehead, 2000). It is a heterogeneous condition in that some patients may experience diarrhea, constipation, or a combination of both (alternating). There are no known biologic markers by which IBS can be diagnosed; consequently, the diagnosis depends on the presence of specific GI symptoms along with the absence of organic disease. Various factors have been implicated in the etiology and pathophysiology of IBS, including stress, alterations in motility, visceral hypersensitivity, autonomic nervous system imbalance, and small intestinal bacterial overgrowth (Drossman, 2006).

Although it is not clear whether stress (or stressors) directly causes IBS, it is accepted that stress can trigger or exacerbate symptoms in patients with IBS (Mayer, 2000; Whitehead, Crowell, Robinson, Heller, & Schuster, 1992). These observations are consistent with a biopsychosocial model of IBS. The biopsychosocial model is a heuristic model that links physiological reactions in IBS (e.g., altered gut motility and increased visceral sensitivity) and subsequent IBS symptoms to psychological factors (e.g., psychological distress, coping skills, and personality) and environmental or social factors (e.g., life stressors; Camilleri & Spiller, 2002). The model is general and is not specific as to causal pathways or time frame of action. In particular, it encompasses the possibility that the sequelae of stress can occur within minutes, hours, or days of an acute stressor or can result from chronic stress over weeks or months.

There is much literature on stress and stressors and their impact on psychological and physiological responses throughout the body, including the GI tract. Beginning with the early work of Cannon and Rosenblueth (1937) on the fight or flight phenomenon and the landmark papers of Selye (1950) on the general adaptation syndrome, the GI...
tract has been a target of study when examining the impact of physiological and psychosocial stress.

In examining the literature on stress in patients with IBS, it is evident that investigators employ different operational definitions of stress. Stress has been conceptualized most frequently as the number of recalled stressful events (Dancey, Taghavi, & Fox, 1998; Drossman et al., 1988; Whitehead et al., 1992) and the prospective reporting of daily perceptions of stress (Jarrett et al., 1998; Levy, Cain, Jarrett, & Heitkemper, 1997; Suls, Wan, & Blanchard, 1994). Few researchers have explored the role of chronic stress, and even fewer have investigated this association longitudinally. Bennett, Tennant, Pesse, Badcock, and Kellow (1998) examined the link between chronic life event stressors and GI, extraintestinal, and emotional symptoms using semistructured interviews, including the Life Events Survey (LES) and the Difficulties Schedule. Chronic stress was defined as life stress present for at least 6 months. They found that chronic and severe stressful events in the individual’s life during the previous 12 months was the only factor that consistently correlated with current levels of GI, emotional, and extraintestinal symptoms.

The study of stress in IBS has relied on both retrospective and, to a limited degree, prospective or daily reports of stress. Whitehead et al. (1992) used the retrospective LES as an indicator of psychological distress and found that patients with IBS reported fewer positive and negative life events than did women with GI symptoms compatible with IBS but no diagnosis of IBS (IBS nonpatients). Levy et al. (1997) also used the LES to examine differences in stress in women with chronic IBS, IBS nonpatients, and women without chronic GI symptoms. Women’s recall of life events over the prior year was similar among the three groups. However, when daily measures of stress were used along with GI symptoms and were compared across groups, differences did emerge. Levy et al., using a 30-day diary, found higher mean GI symptom severity and stress reports in IBS and IBS nonpatient groups as compared with a non-IBS comparison group. Furthermore, using within-woman analyses, Levy et al. found that approximately half of the women with IBS and 15% of the women without IBS showed a significant positive correlation between daily reports of stress and a composite score of GI symptoms. These results are similar to those reported by Dancey et al. (1998), who used a daily GI symptom severity and a weekly measure of hassles. These results are in contrast to the work of Suls et al. (1994), which found no relationship between self-report of daily stress and GI symptom reports in a study of 44 IBS patients.

A challenge in examining the role of stress in GI symptom reports in IBS patients is separating the stressful event from the psychological reaction (depression and anxiety; Naliboff et al., 2004). In the Suls et al. (1994) study, using a one-time measure of the patients’ psychiatric history, the authors report that controlling for anxiety had no impact on the link between stress and GI symptoms. Few studies to date have examined the relationships among daily stress, daily psychological distress, and daily GI symptoms or have determined whether the relationships vary depending on predominant bowel pattern subgroups. These bowel pattern subgroups appear to differ on a number of physiological variables, including autonomic nervous system balance indicators (Aggarwal et al., 1994; Heitkemper et al., 2001) and GI transit and motility (Chey, Jin, Lee, Sun, & Lee, 2001; Serra, Azpizroz, & Malagelada, 2001). In a comparison of psychological distress indicators in women with IBS-constipation (IBS-C), IBS-diarrhea (IBS-D), and IBS-alternating (IBS-A), Tillisch et al. (2005) found that psychological distress was greater in women in the IBS-A group relative to women in the IBS-C and IBS-D groups.

The purpose of this article is to replicate prior work (Levy et al., 1997) in a larger sample of women and to extend that work by examining the relationship of stress to abdominal discomfort symptoms, bowel pattern symptoms, and psychological distress in subgroups (IBS-C, IBS-D, and IBS-A) of women with IBS. Based on earlier studies, it was hypothesized that women with IBS would report higher levels of stress and psychological distress compared with women without IBS. Second, it was hypothesized that intensity of stress would be associated with severity of abdominal discomfort symptoms and bowel pattern symptoms and that these relationships would be moderated by psychological distress. Based on the literature (Tillisch & Chang, 2005), it was hypothesized that the relationship of stress to psychological distress and GI symptoms would be stronger in the IBS-A group. As noted above, there is extensive literature on the question of how to best conceptualize stress, whether as objective external events or stressors, an individual’s perception of such stressors, the psychological response, or the physiological response to perceived stressors. In this analysis, responses to three questions on a daily diary related to stress (e.g., “How stressful today was your job [or school]?”) were used. This is probably best interpreted as an individual’s perception of stressful events, although it may also be confounded with the psychological response of the individual to this perceived stress.

**Methods**

**Design**

This report is a secondary analysis of data collected in two samples of women: an observational study of autonomic nervous system function (NINR RO1 NR04101) and the baseline assessment of a randomized controlled trial (NINR RO1 NR04142). The data for these studies were collected between 1996 and 2004.

**Sample**

The sample consisted of 241 women, 187 with IBS and 54 without IBS. The inclusion criteria for IBS patients were based on the International Gastroenterology Rome-I Research criteria (Thompson, Dotevall, Drossman, Heaton, & Kruis, 1989). Women with IBS had to have current symptoms of abdominal pain relieved by a bowel movement or associated with stool changes, and two of the following four symptoms: (a) fewer or more frequent stools; (b) harder or looser stools; (c) straining, urgency, or feeling of incomplete evacuation; or (d) passage of mucus with stools. Women in the comparison group had to have denied having symptoms of IBS (i.e., Rome-I Research criteria). Potential participants were excluded if they had...
a history of GI pathology (e.g., inflammatory bowel disease), GI surgery (e.g., bowel resection), renal pathology, or gynecological pathology (e.g., endometriosis) that might result in IBS-type symptoms. Women with IBS were denied enrollment if they were taking specific medications for IBS on a regular basis (e.g., antidiarrheals, laxatives, or anti-spasmodics three or more times a week).

Procedures
Similar recruitment strategies (local community advertisements and a direct mailing to patients with IBS from a local health maintenance organization [Group Health Cooperative of Puget Sound]) were utilized in both studies. Details of the protocols from these studies have been described elsewhere (Heitkemper et al., 2004; Motzer, Hertig, Jarrett, & Heitkemper, 2003). Potential participants were screened by telephone to determine eligibility. All participants gave written consent prior to completing the questionnaires and testing, which was approved by the institutional review board. Participants started the Daily Health Diary (DHD) on the first day of menses and continued through the first 5 days of their next menses (approximately 33 days). The women were modestly compensated for their time.

Measures
Daily Stress, GI, and Psychological Symptoms
Daily stress intensity was based on three questions in the DHD: How stressful was your relationship with others (not children), your role as a parent, and your job (or school)? Each question was rated from 0 (not at all) to 6 (extremely severe). The maximum intensity from any one of the three stress questions was used as the measure of stress on a daily basis. The symptom section of the DHD included abdominal discomfort symptoms (abdominal pain, bloating, and intestinal gas), bowel pattern symptoms (constipation and diarrhea), and symptoms of psychological distress (anxiety and depression), which were rated from 0 (not present) to 4 (extreme). The DHD was used because it decreases retrospective bias associated with recalled symptoms (e.g., usual symptoms vs. close to the experience), the responses are sensitive to changes in symptoms over time, and the responses show construct validity when correlated with global scales (Burman, 1995; Carp & Carp, 1981; Rakowski, Julius, Hickey, Verbrugge, & Halter, 1988).

Retrospective Stress, GI, and Psychological Symptoms
The Daily Hassles Scale was used as an indicator of retrospective stress. It consists of 117 items used to measure the frequency and severity of negative encounters with the environment that are considered to be stressful events. Participants rated how much of a hassle the experience was over the past month using a 4-point scale: 0 (none or did not occur) to 3 (extremely severe). Global scoring consists of frequency (number of hassles endorsed by the participant), severity (the average severity rating of all items that have been endorsed), and a total score (sum of all ratings). Acceptable validity and reliability measures have been reported by Lazarus and Folkman (1996).

Information on symptoms over the past year was collected with the Bowel Disease Questionnaire (BDQ). The BDQ is a 97-item inventory of symptoms recalled over the prior year (e.g., abdominal pain, usual bowel pattern, and straining with bowel movement). In addition, there are questions related to GI diagnostic testing, number of doctor or physician visits in the past year, and the impact of bowel symptoms on life activities. Test–retest $\kappa$ statistics for the individual BDQ items ranged from .52 to 1.0, with a mean $\kappa$ of .78 in a large ($N = 361$) reliability study (Talley, Phillips, Melton, Wilfgen, & Zinsmeister, 1989; Talley, Phillips, Wilfgen, Zinsmeister, & Melton, 1990). Responses from the BDQ were used to classify participants into bowel predominant subgroups.

The Symptom Checklist-90R (SCL-90) is used to measure psychological distress over the prior week (Derogatis, 1994; Derogatis & Cleary, 1977). It includes 90 symptom items that are rated from 0 (not at all) to 4 (extreme). All 90 items are used to compute a mean Global Severity Index (GSI), and subsets of items are used to compute mean anxiety and depression subscales.

Demographic information on age, race, education, marital status, and income was collected.

IBS Subgroups
The IBS participants were divided into subgroups based on symptoms that represent a predominant bowel pattern (Drossman et al., 2000). The criteria uses three constipation symptoms (<3 stools/week, hard stools, and straining) and three diarrhea symptoms (>3 stools/day, loose stools, and urgency). Classification as IBS-C was made if the woman had (a) at least one constipation symptom and no diarrhea symptoms or (b) at least two constipation symptoms and only one diarrhea symptom. Classification as IBS-D was made if the woman had (a) at least one diarrhea symptom or no constipation symptoms or (b) at least two diarrhea symptoms, no hard stools, and only one of the other constipation symptoms. Those participants not meeting the criteria for IBS-C or IBS-D but who had at least one constipation symptom and at least one diarrhea symptom were classified as IBS-A. Using this approach, 54 women were classified as IBS-C, 70 women, as IBS-D; and 63 women, as IBS-A.

Data Analysis
Student’s $t$ tests and one-way analysis of variance were used to compare mean psychological distress and stress between women with IBS and women in the comparison group and among the three IBS subgroups.

Two approaches were used to analyze the relationship between stress and GI symptoms from the DHD. In the first approach, across-women correlations were estimated. For each woman, data from all diary days were averaged to get the mean stress and the mean of a specific GI symptom for that woman. Then, the correlations between mean stress and mean GI symptom were computed. Correlations were estimated overall and also separately within each IBS subgroup. Partial correlations, controlling for mean anxiety and depression, were computed to evaluate the potential mediating effect of psychological distress. These across-women correlations measure the extent to which women who, on average, have more intense stress also have, on average, more severe symptoms.

In the second approach, within-woman correlations between stress and GI symptoms were evaluated. For each
woman, the correlation between stress and a specific GI symptom was computed, using only the daily diary data for that woman. If a woman has a positive correlation between stress and abdominal pain, for example, it means that on days that she has more stress, she also has more abdominal pain. The null hypothesis is that the true within-woman correlation between stress and the symptom is 0 for all women, whereas the alternative hypothesis of interest is that most women have a positive within-woman correlation. However, the observed within-woman correlations will differ from the true within-woman correlations due to random variation. Even when the null hypothesis is true, some of the observed within-woman correlations will be positive (defined as >.20 for this analysis) and some will be negative (<-.20), although most should be close to 0. If the null hypothesis is true, the number of positive correlations should be about the same as the number of negative correlations, but if the alternative is true, there should be more women with positive than negative correlations. In this report, results are reported as the percentage of women with a positive (>-.20) within-woman correlation and the percentage with a negative (<-.20) within-woman correlation. The sign test is used to test the null hypothesis that the expected number of women with a positive correlation is the same as the expected number of women with a negative correlation. Also computed were within-woman partial correlations, controlling for daily anxiety and depression. No adjustments were made for multiple comparisons; hence, results should be interpreted cautiously given the large number of p values computed.

Results
Of the 187 women with IBS and 54 women in the comparison group in the original sample, 6 women with IBS and 6 women without IBS were dropped because of incomplete diary data for these analyses. On average, the participants were 32 years of age and predominantly Caucasian (85%), and 49% were married or partnered. There were no significant differences in age, ethnicity, partnered status, occupation, education, and income between women with IBS and women in the comparison group. Similarly, there were no differences in demographic characteristics across IBS bowel pattern subgroups. Of the total sample, over half of the women (n = 159) had completed college, a third (n = 88) held professional-managerial positions, and 43 were students.

Group Comparisons
Data from the Hassles scale and the SCL-90 are used in this report to describe the sample. Women with IBS retrospectively reported more frequent and more intense hassles than did women without IBS (Table 1). Similarly, on the SCL-90, women with IBS reported more psychological distress, as reflected in the GSI and the anxiety and depression subscales. On the DHD, women with IBS reported more stress overall as well as stress related to parenting, relationships, and school or job.

| TABLE 1. Comparison of Stress, Hassles, and Psychological Distress in a Comparison Group of Women Without Irritable Bowel Syndrome (IBS), in Women With IBS, and Among IBS Subgroups |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | **Control (n = 48)** | **IBS (n = 181)** | **IBS-C (n = 52)** | **IBS-D (n = 67)** | **IBS-A (n = 62)** |
| **Stress**      |                 |                 |                 |                 |                 |
| Diary stress (maximum) | 1.82 (0.8) | 2.25 (0.9) | .004 | 2.19 (0.9) | 2.10 (0.9) | 2.49 (1.0) | .048^c |
| Diary parenting | 0.95 (1.0) | 1.61 (0.9) | .010 | 1.77 (0.9) | 1.52 (1.0) | 1.54 (1.0) | ns |
| Diary relationships | 1.14 (0.9) | 1.54 (0.9) | .006 | 1.49 (0.7) | 1.37 (0.8) | 1.78 (1.0) | .024^c |
| Diary job or school | 1.72 (1.1) | 2.10 (1.1) | .034 | 2.01 (1.1) | 1.92 (1.0) | 2.33 (1.2) | .095^c |
| Hassles: total | 42.3 (29) | 71.6 (43) | <.001 | 68.8 (37) | 67.2 (41) | 82.3 (49) | ns |
| Hassles: frequency | 31.5 (17) | 46.0 (19) | <.001 | 46.3 (17) | 43.6 (21) | 50.2 (20) | ns |
| Hassles: severity | 1.26 (0.2) | 1.47 (0.3) | <.001 | 1.42 (0.3) | 1.46 (0.3) | 1.53 (0.4) | ns |
| **Psychological distress** |                 |                 |                 |                 |                 |
| Diary: anxiety | 0.61 (0.6) | 1.07 (0.7) | <.001 | 1.02 (0.8) | 1.03 (0.7) | 1.20 (0.8) | ns |
| Diary: depression | 0.36 (0.4) | 0.82 (0.7) | <.001 | 0.78 (0.6) | 0.81 (0.8) | 0.89 (0.8) | ns |
| SCL-90: GSI mean score | 0.30 (0.3) | 0.63 (0.4) | <.001 | 0.59 (0.4) | 0.57 (0.4) | 0.76 (0.5) | ns |
| SCL-90: anxiety | 0.24 (0.3) | 0.55 (0.6) | <.001 | 0.48 (0.5) | 0.48 (0.5) | 0.71 (0.7) | ns |
| SCL-90: depression | 0.45 (0.4) | 0.91 (0.7) | <.001 | 0.81 (0.6) | 0.88 (0.7) | 1.06 (0.8) | ns |

Note. The values outside of the parentheses are mean values and the values inside the parentheses are standard deviations. Diary stress (maximum) refers to the maximum intensity from any one of the following three stress questions and was used as the measure of stress on a daily basis. IBS-C = IBS-constipation; IBS-D = IBS-diarrhea; IBS-A = IBS-alternating; SCL-90 = Symptom Checklist-90R; GSI = Global Severity Index; ns = not significant; p > .10.
^Independent t test.
^One-way analysis of variance among IBS subgroups using Tukey B pairwise comparison.
^IBS-A > IBS-D.
Despite the greater report of hassles by the IBS-A group, there are no significant differences in total hassles, hassles frequency, or hassles intensity among the IBS bowel pattern subgroups. Similarly, there are no significant differences in the GSI or the anxiety and depression subscales of the SCL-90 among the IBS subgroups. However, the IBS-A subgroup again scored higher. On the daily diary, among IBS bowel pattern subgroups, there are no overall group differences in the mean of the three stress items. With regard to relationship and work stress, the IBS-A group had significantly higher levels of stress.

**Across-Women Correlations**

In the total sample of IBS women, there were weak to moderate across-women correlations between stress and GI symptoms (Table 2). Abdominal pain, bloating, and intestinal gas were correlated more strongly with stress than were the bowel pattern symptoms diarrhea and constipation. The strongest relationships were found between stress and the psychological distress variables anxiety and depression. In the comparison group, there are similarly significant relationships between stress and psychological distress symptoms.

Within the three bowel pattern subgroups, abdominal pain and intestinal gas were correlated significantly with stress (Table 2). Overall, correlations of stress with abdominal discomfort symptoms were similar across the three IBS subgroups, except that the correlation of stress with bloating was much stronger in IBS-A than in the other two subgroups. Controlling for anxiety and depression substantially reduced the relationships between stress and GI symptoms in all subgroups. Twenty percent of the IBS participants and 6% of the women in the comparison group were taking antidepressants, whereas only one in the comparison group was taking an antianxiety medication. A post hoc analysis was performed repeating across-women correlations while controlling for antidepressant and antianxiety medication use; there were no differences from the results presented.

**Within-Woman Analysis**

In Table 3, within-woman analyses are presented as the percentages of correlations that were $>.20$ and $<-0.20$. In both the comparison group and the IBS group, there was strong evidence of positive within-woman associations of stress to depression and anxiety, as evidenced by most women having positive correlations. There was also some evidence that abdominal pain and bloating were more likely to be correlated positively with stress, although this trend was generally not statistically significant. Partial correlations of stress with abdominal discomfort symptoms, controlling for anxiety and depression, were weaker. Evaluation of the relationship between stress and symptoms was calculated using previous-day stress and using the mean of previous-day with current-day stress. The results from these analyses did not vary from those reported above.

**Discussion**

The results of these secondary analyses confirm the study hypotheses. Women with IBS report significantly more stress and greater psychological distress as compared with women in

### TABLE 2. Across-Women Correlations Between Stress and Gastrointestinal and Psychological Symptoms in a Comparison Group of Women Without Irritable Bowel Syndrome (IBS), Women With IBS, and Among IBS Subgroups

<table>
<thead>
<tr>
<th></th>
<th>Controls ($n = 48$)</th>
<th>All IBS ($n = 181$)</th>
<th>IBS-C ($n = 52$)</th>
<th>IBS-D ($n = 67$)</th>
<th>IBS-A ($n = 62$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stress with</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>.026</td>
<td>.385***</td>
<td>.374**</td>
<td>.284*</td>
<td>.432***</td>
</tr>
<tr>
<td>Bloating</td>
<td>.214</td>
<td>.241***</td>
<td>.176</td>
<td>.096</td>
<td>.353**</td>
</tr>
<tr>
<td>Constipation</td>
<td>.018</td>
<td>.216***</td>
<td>.171</td>
<td>.214†</td>
<td>.220†</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>.276†</td>
<td>.125†</td>
<td>.109</td>
<td>.238†</td>
<td>.071</td>
</tr>
<tr>
<td>Intestinal gas</td>
<td>.006</td>
<td>.351***</td>
<td>.277</td>
<td>.403***</td>
<td>.328**</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.464***</td>
<td>.600***</td>
<td>.446***</td>
<td>.617***</td>
<td>.657***</td>
</tr>
<tr>
<td>Depression</td>
<td>.350*</td>
<td>.471***</td>
<td>.208</td>
<td>.503***</td>
<td>.594***</td>
</tr>
<tr>
<td><strong>Stress, controlled for anxiety and depression, with</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>−.094</td>
<td>.145†</td>
<td>.260†</td>
<td>−.031</td>
<td>.169</td>
</tr>
<tr>
<td>Bloating</td>
<td>.151</td>
<td>−.003</td>
<td>.000</td>
<td>−.085</td>
<td>.043</td>
</tr>
<tr>
<td>Constipation</td>
<td>−.151</td>
<td>.075</td>
<td>.100</td>
<td>−.027</td>
<td>.016</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>.241</td>
<td>.067</td>
<td>−.056</td>
<td>.235†</td>
<td>.003</td>
</tr>
<tr>
<td>Intestinal gas</td>
<td>−.061</td>
<td>.149†</td>
<td>.187</td>
<td>.189</td>
<td>.056</td>
</tr>
</tbody>
</table>

Note. IBS-C = IBS-constipation; IBS-D = IBS-diarrhea; IBS-A = IBS-alternating.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

† $10 > p > .05$. 
the comparison group. No significant differences are noted among the IBS subgroups. Second, across women, stress is associated significantly with severity of abdominal discomfort symptoms but not bowel pattern symptoms. The strongest associations, however, are seen between stress and psychological distress. The relationships between stress and abdominal discomfort are reduced substantially when controlling for anxiety and depression. Within-woman analyses showed little evidence of relationship between day-to-day variations in stress and day-to-day variations in abdominal discomfort or bowel pattern symptoms. However, stress is related strongly to daily anxiety and depression in the within-woman analysis.

The higher levels of daily stress reported by women with IBS, regardless of bowel pattern predominance, is similar to that previously reported (Dancey et al., 1998; Levy et al., 1997; Whitehead et al., 1992). The association between stress and severity of GI symptoms has also been reported previously (Bennett, Tennant, et al., 1998; Dancey et al., 1998; Levy et al., 1997). However, controlling for daily anxiety and depression substantially reduces the relationships between stress and nearly all abdominal distress symptoms in the total sample as well as subgroups. These two observations may indicate that psychological distress moderates the relationship between stress and GI symptoms. Naliboff et al. (2004) has suggested that the link between stress and GI symptoms is influenced by the individual’s psychological response to the symptom. The strong across- and within-woman relationships between stress and both anxiety and depression may reflect the psychological toll of chronic exposure to stress (Bennett, Piesse, et al., 1998). Alternatively, it may be that overlap in measurement of the constructs of stress and psychological distress induces the strong correlation between the two.

The role of psychological distress in the initiation and perpetuation of GI complaints is complex. Bennett, Piesse, et al. (1998) found that patients with high levels of psychological distress were less likely to see improvement in their GI symptoms over time. The argument has been made that psychological distress is not unique to IBS but rather reflects illness behavior (Whitehead, Bosmajian, Zonderman, Costa, & Schuster, 1988) or gender-related population differences (Chang & Heathcote, 2002). In this study, the comparison group also showed significant correlations between stress and anxiety and depression but not GI symptoms indicative of abdominal distress (i.e., abdominal pain, bloating, or intestinal gas). The relationship between psychological distress and GI symptoms may be influenced by genetic differences, at least in a subset of women with IBS. For example, serotonin is important to both mood and bowel function. A recent study of polymorphisms in the serotonin reuptake transporter protein found that a subgroup of women with IBS who were homozygous for the short allele of 5-HTTLPR or carried a STin2.9 VNTR allele were more likely to have a history of depressive episodes (Jarrett et al., in press). Yeo et al. (2004) reported that women with IBS-D were twice as likely (odds ratio = 2.3, 95% confidence interval = 1.5–3.3) to have an s/s genotype compared with those with an l/s or l/l genotype.

### TABLE 3. Percentage of Positive (>0.20) and Negative (<–0.20) Within-Woman Correlations Between Stress and Abdominal, Bowel Pattern, and Psychological Symptom Distress in a Comparison Group of Women Without Irritable Bowel Syndrome (IBS), Women With IBS, and Among IBS Subgroups

<table>
<thead>
<tr>
<th>Stress with:</th>
<th>Controls (n = 48)</th>
<th>All IBS (n = 181)</th>
<th>IBS-C (n = 52)</th>
<th>IBS-D (n = 67)</th>
<th>IBS-A (n = 62)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal pain</td>
<td>8/2</td>
<td>21/12</td>
<td>23/8</td>
<td>27/18</td>
<td>13/10</td>
</tr>
<tr>
<td>Bloating</td>
<td>25/2**</td>
<td>24/15</td>
<td>27/17</td>
<td>22/15</td>
<td>24/13</td>
</tr>
<tr>
<td>Constipation</td>
<td>12/6</td>
<td>17/14</td>
<td>21/19</td>
<td>13/13</td>
<td>18/11</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>17/6</td>
<td>19/18</td>
<td>14/14</td>
<td>24/18</td>
<td>19/21</td>
</tr>
<tr>
<td>Intestinal Gas</td>
<td>10/12</td>
<td>20/15</td>
<td>27/14</td>
<td>18/16</td>
<td>16/15</td>
</tr>
<tr>
<td>Anxiety</td>
<td>80/2***</td>
<td>80/0***</td>
<td>87/0***</td>
<td>75/0***</td>
<td>81/0***</td>
</tr>
<tr>
<td>Depression</td>
<td>56/6***</td>
<td>58/4***</td>
<td>69/2***</td>
<td>46/5***</td>
<td>61/5***</td>
</tr>
</tbody>
</table>

**Stress, controlled for anxiety and depression, with:**

| Abdominal pain | 9/9              | 16/15            | 13/13          | 23/19          | 12/15          |
| Bloating      | 16/9             | 20/14            | 15/23          | 19/15          | 28/10*         |
| Constipation  | 7/11             | 11/16            | 8/17           | 14/12          | 10/20          |
| Diarrhea      | 21/7             | 16/19            | 17/15          | 15/23          | 18/21          |
| Intestinal gas | 5/9              | 19/19            | 27/21          | 17/19          | 16/16          |

Note. Values are presented as % Pos/% Neg. % Pos = the percentage of within-woman correlations that were greater than .20; % Neg = the percentage of within-woman correlations that were less than −.20; IBS-C = IBS-constipation; IBS-D = IBS-diarrhea; IBS-A = IBS alternating.

*p < .05.

**p < .01.

***p < .001.

.10 > p = .05.
Abdominal pain, bloating, and intestinal gas are correlated more strongly with stress than are the bowel pattern symptoms constipation and diarrhea. Abdominal pain in particular is shown to have the greatest impact on quality of life indicators in women with IBS (Cain et al., 2006; Lembo et al., 1999). When controlling for anxiety and depression, the relationship between stress and abdominal pain remains a trend (p < .235) in the IBS-C group.

Only those women in the IBS-D group demonstrate a trend in the relationship (r = .235) between daily stress and their predominant bowel symptom when controlling for anxiety and depression. Women in the comparison group also demonstrate a trend in the relationship between stress and diarrhea; the relationship only weakened a little when depression and anxiety were controlled. In an earlier report, it was noted that diarrhea independently correlated with quality of life even when controlling for abdominal pain in women with IBS (Cain et al., 2006). The link between stress and diarrhea may be related to either increased intestinal transit or increased intestinal secretion subsequent to stress. Using jejunal biopsy tissues, Guilarte et al. (2007) found both increased psychological distress scores and mast cell numbers in IBS-D patients. They hypothesized that distorted autonomic patterns (e.g., heightened parasympathetic or sympathetic nervous system response to stress) and neuroendocrine abnormalities in the hypothalamic–pituitary–adrenal axis may be associated with intestinal cell changes. Data from this group support the influence of stress and corticotropin-releasing hormone in the regulation of intestinal epithelial and immune function via mast cell activation (Santos, Guzzi, & Malagelada, 2005).

The pattern of GI symptoms may involve varying temporal relationships of stress (i.e., a lag relationship between stress and altered transit or secretion). Despite the fact that all three groups demonstrated a strong correlation between stress and abdominal pain when across-women analyses were performed, few women had a significant within-individual correlation between same-day stress and abdominal discomfort or bowel pattern. Testing prior-day stress and current-day plus prior-day stress levels with GI symptoms did not change the results in an earlier reported study (Levy et al., 1997) or in this study.

The stronger across-women correlations between overall symptoms and stress in the IBS-A group as compared with the IBS-C and IBS-D groups may be related to higher levels of relationship stress and work-related stress as well as hassles found in this subgroup. Although the differences are not consistently significant, women in the IBS-A subgroup tend to report higher levels of anxiety and depression than do women in either the IBS-C or IBS-D groups. This is consistent with the observation of Tillisch et al. (2005), who found that women with alternating bowel habits had more frequent symptoms and increased psychological comorbidity. Women with IBS-C also report the lowest quality of life (Cain et al., 2006; Coffin, Dapoigny, Cloarec, Comet, & Dyard, 2004). Lackner and Gurtman (2005), in a study of interpersonal problems of IBS patients, found that, in general, IBS patients relative to individuals without IBS have a distinct pattern of interpersonal problems (e.g., more difficulties with assertiveness, social inhibition [easily embarrassed or anxious]). It can be hypothesized that these interpersonal issues contribute to self-reports of relationship and work-related stress. Interestingly in Lackner and Gurtman’s study, which included a small percentage of male IBS patients, the IBS-D group reported greater problems with submissiveness as compared with IBS-C and IBS-A groups.

On the other hand, fluctuations of bowel symptoms such as that experienced by women in the IBS-A group may be more stressful than consistent diarrhea or constipation. Until recently, patients with an alternating pattern of constipation and diarrhea have been studied less. Patients have been either excluded or placed within an IBS-C or IBS-D group (Drossman et al., 2005). In a 1-year prospective assessment of bowel patterns, Drossman et al. (2005) found that women in the IBS-A group were most likely to transition to another subgroup (i.e., IBS-C or IBS-D), whereas those in the IBS-C and IBS-D groups remained relatively stable. Such transitions speak to the unpredictability of symptoms in this patient group.

There are several important limitations to the study. It was not possible to distinguish between the objective stressor and the woman’s perception of how stressful it was. Single items were used in the analysis for each of the GI symptoms and for anxiety and depression. As noted previously, multiple comparisons were made.

In summary, women with IBS report significantly more stress and greater psychological distress compared with women in the comparison group. Across women, stress is associated significantly with severity of abdominal discomfort symptoms but not bowel pattern symptoms. The relationships between stress and abdominal discomfort symptoms are reduced when controlling for anxiety and depression. Within- woman analyses show little evidence of relationship between stress and abdominal discomfort and bowel pattern symptoms; however, stress is related strongly to anxiety and depression. Prior work (Heitkemper et al., 2004) has demonstrated that a multicomponent cognitive behavioral therapy program delivered by advance practice nurses can reduce symptom distress and enhance quality of life in women with IBS. The IBS treatment protocols that incorporate strategies to decrease stress and subsequent psychological distress are likely to reduce GI symptoms for many patients regardless of bowel predominant symptoms.

Accepted for publication August 27, 2007.

This research was funded by the National Institute of Nursing Research, National Institutes of Health (NR07039, NR04101, and NR04142).

Corresponding author: Vicky L. Hertig, PhD, RN, Department of Behavioral Nursing & Health Systems, Box 357266, University of Washington, Seattle, Seattle, WA 98195 (e-mail: vhertig@uw washington.edu).

References


