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Is Childhood Abuse or Neglect Associated With Symptom Reports and Physiological Measures in Women With Irritable Bowel Syndrome?

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Purpose. Early childhood traumatic experiences (e.g., abuse or neglect) may contribute to sleep disturbances as well as to other indicators of arousal in patients with irritable bowel syndrome (IBS). This study compared women with IBS positive for a history of childhood abuse and/or neglect to women with IBS without this history on daily gastrointestinal (GI), sleep, somatic, and psychological symptom distress, polysomnographic sleep, urine catecholamines (CAs) and cortisol, and nocturnal heart rate variability (HRV). *Methods.* Adult women with IBS recruited from the community were divided into two groups: 21 with abuse/neglect and 19 without abuse/neglect based on responses to the Childhood Trauma Questionnaire (CTQ; physical, emotional, sexual abuse, or neglect). Women were interviewed, maintained a 30-day symptom diary, and slept in a sleep laboratory. Polysomnographic and nocturnal HRV data were obtained. First-voided urine samples were assayed for cortisol and CA levels. *Results.* Women with IBS positive for abuse/neglect history were older than women without this history. Among GI symptoms, only heartburn and nausea were significantly higher in women with abuse/neglect. Sleep, somatic, and psychological symptoms were significantly higher in women in the abuse/neglect group. With the exception of percentage of time in rapid eye movement (REM) sleep, there were few differences in sleep-stage variables and urine hormone levels. Mean heart rate interval and the natural log of the standard deviation of RR intervals for the entire sleep interval (Ln SDNN) values were lower in those who experienced childhood abuse/neglect. *Conclusion.* Women with IBS who self-report childhood abuse/neglect are more likely to report disturbed sleep, somatic symptoms, and psychological distress. Women with IBS should be screened for adverse childhood events including abuse/neglect.

Keywords
irritable bowel syndrome, women's health, sleep, childhood abuse, childhood neglect

Worldwide approximately 7–10% of people report gastrointestinal (GI) symptoms compatible with a diagnosis of irritable bowel syndrome (IBS; Spiegel, 2009). IBS is a functional GI disorder characterized by abdominal pain and alterations in bowel pattern (i.e., constipation, diarrhea, or mixed diarrhea–constipation). Patients with IBS frequently report a number of non-GI symptoms including poor sleep and fatigue (Kato, Sullivan, Evengard, & Pedersen, 2009). We, as well as others, have shown that patients with IBS self-report poorer sleep quality (e.g., difficulty getting to sleep and awakening during the night) when compared to healthy controls (Burr, Jarrett, Cain, Jun, & Heitkemper, 2009; Elsenbruch, Thompson, Hamish, Exton, & Orr, 2002; Jarrett, Heitkemper, Cain, Burr, & Hertig, 2000; Ono, Komada, Kamiya, & Shirakawa, 2008; Robert, Elsenbruch, & Orr, 2006). Together, these results suggest that IBS patients may be hyperaroused in relation to both internal and external stimuli. Chronic hyperarousal can be defined as an abnormal state of activation that can occur as a results of traumatic or highly stressful events (Kendall-Tackett, 2000).

The physical and psychological factors that contribute to hyperarousal in patients with IBS remain to be fully explicated. One predisposing factor may be childhood adverse events including emotional, physical, and/or sexual abuse or loss of a parent through death or divorce. Approximately 30–50% of

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women with IBS report a history of early life adverse events including abuse (Chitkara, van Tilburg, Blois-Martin, & Whitehead, 2008; Delvaux, Denis, & Allemand, 1997; Drossman, 1997; Talley, Boyce, & Jones, 1998). In an early report, Drossman found that a third of women with a functional bowel disorder had a history of rape or incest (Drossman, 1997). Delvaux and colleagues reported that 31% ($n = 62/196$) of surveyed IBS patients reported a history of abuse in response to an anonymous, self-reporting survey (Delvaux et al., 1997). In a community survey in Minnesota, Talley and colleagues reported that 22% of functional bowel disease patients had a history of abuse (13% sexual and/or physical abuse; Talley et al., 1998). In addition, they noted a significant association between IBS and abuse history (sexual, emotional, and verbal). Han and colleagues recently reported that 51% of 72 women with IBS enrolled in a randomized clinical trial of paroxetine were positive for a history of childhood abuse/neglect (Han et al., 2009). In a systematic review of 25 studies, Chitkara and colleagues found that for a proportion of patients with IBS, their symptoms began in childhood and that those with the highest comorbid stress levels may be at greatest risk for symptom persistence (Chitkara et al., 2008).

In addition to IBS, a history of early childhood traumatic experiences is associated with self-reported sleep disturbances and other pain-related conditions (Heitkemper et al., 2005; Holly, Wegman, & Stetler, 2009; Tietjen et al., 2010). However, a history of abuse/neglect has not been linked to subjective or objective sleep indices in patients with IBS. In an earlier report, we found that women with severe IBS symptoms (abdominal pain, constipation, or diarrhea) were significantly more likely than women without IBS to report a history of physical, emotional, and sexual abuse (Heitkemper et al., 2005). The comparison group in that study also included women with a history of abuse and/or neglect, albeit with a lower prevalence than in women with IBS. Given findings that childhood abuse has been associated with poor sleep, it is logical to consider whether abuse history influences indicators of nighttime arousal such as increased catecholamine (CA) and cortisol excretion, reduced heart rate variability (HRV), and disturbed objective and subjective sleep measures in women with a positive history of abuse/neglect.

It has been suggested that adults with a history of severe negative experiences in childhood are more susceptible to stressors as adults (Maunder, Peladeau, Savage, & Lancee, 2010). For example, individuals with a history of abuse may be more likely to develop insomnia particularly when stressed. Laboratory studies involving comparisons of patients with and without abuse history have been limited. In a recent report, Videlock and colleagues (2009) reported that patients (men and women) with a history of early life adverse events demonstrate hyperresponsiveness as evidenced by increased salivary cortisol response to a visceral stressor (sigmoidoscopy). In their study of healthy controls and IBS patients, only salivary cortisol as a component of the hypothalamic-pituitary-adrenal axis was measured.

The purpose of the current analysis was to compare women with IBS positive for a history of childhood abuse/neglect to women with IBS and no history of abuse/neglect on self-report GI symptom, sleep, somatic, and psychological distress severity, polysomnography (PSG) determined sleep quality, nocturnal HRV, and first-void urine measures of CAs and cortisol. We hypothesized that those with a history of childhood abuse/neglect would report increased GI and other symptom distress, more sleep disruptions, reduced nocturnal HRV, and increased stress-hormone secretion.

Materials and Method

Design

Data were obtained as part of an observational study of sleep and GI symptoms in women with IBS ($n = 40$) and healthy comparison women ($n = 36$; Heitkemper et al., 2005). Only healthy comparison women with no reported history of abuse or neglect are included in the analyses. Within the IBS group, comparisons were made based on the presence of a positive self-reported childhood history of emotional, physical, and/or sexual abuse or neglect. Comparisons included measures of psychological distress, GI symptoms, sleep (self-report and objective PSG), urine cortisol and CA levels, and HRV indices in addition to demographic characteristics.

Sample

We have described the characteristics of the comparison group and the total IBS sample elsewhere (Heitkemper et al., 2005). In brief, women with IBS and healthy control women, 18 to 46 years of age, were recruited through community advertisements. The study was conducted between 2001 and 2005. Women in the IBS group had to have a medical diagnosis of IBS and currently be experiencing symptoms compatible with the Rome-II criteria for IBS. Women in the comparison group were excluded if they had symptoms of a functional GI disorder. Exclusion criteria for both groups included (a) a history of GI pathology (e.g., inflammatory bowel disease), (b) GI surgery, renal, or gynecological pathology that might result in IBS symptoms (e.g., bowel resection, endometriosis), (c) a significant comorbid condition (excluding treated hypothyroidism, mild asthma), (d) a known cardiac dysrhythmia, (e) a sleep disorder, (f) taking medications that could interfere with sleep, cortisol, CAs, or HRV, such as beta blockers, antihistamines, benzodiazepines, or antidepressants (e.g., selective serotonin reuptake inhibitors [SSRIs]), or (g) taking GI prokinetic or serotonergic agents. Women could also not be using hormonal contraceptives. We obtained human subjects' committee approval prior to recruitment. Of the women enrolled, four in the IBS and three in the control group withdrew from the study because they reconsidered the time the study would take or had too low hematocrit or two anovulatory cycles. In addition, eight women did not complete the sleep laboratory protocol (reasons given were, e.g., illness) but did complete their diary and Pittsburgh Sleep Quality Index (PSQI) questionnaire.

This report presents results from the 72 women (32 controls, 21 women with IBS with a history of abuse/neglect, and 19 women with IBS and no history of abuse/neglect) who provided data on at least one of the outcome variables analyzed here. However, not all women provided data on all of the outcome variables, as can be seen by the varying *N*s in the tables.

Procedures

Subjects came to the university sleep laboratory for their initial interview, gave written consent, completed questionnaires, and were oriented to the study procedures and sleep laboratory. The protocol began at the start of each woman's next menses. The women completed a daily symptom diary for one menstrual cycle, tested their urine for the luteinizing hormone (LH) surge (ClearPlan Easy, Unipath Research: Princeton, New Jersey), and slept three nights in the laboratory beginning on Day 7 (± 2 days) after a positive LH surge, mid-luteal phase. Based on the menstrual cycle, women collected a urine sample, first after waking, twice in the follicular phase, three times in luteal phase, and on Day 1 or 2 of menses. The women were financially compensated for their participation in the study.

Sleep Assessment Protocol

We described the sleep assessment protocol elsewhere (Heitkemper et al., 2005). For this analysis, only the second-night data of a three-night sleep laboratory protocol was used. The first night was for adaptation to the laboratory, and subjects were screened for apnea/hypopnea and periodic leg movements. Women were instructed to refrain from drinking caffeinated beverages, taking acetaminophen or aspirin within 6 hr of bedtime, drinking any alcohol, or napping prior to coming to the sleep laboratory. On the second night, women came to the sleep laboratory 2 hr before their normal sleep time and had electrodes placed on their head, face, and chest for a standard PSG assessment. Once the electrode placement was complete, subjects read or watched television in bed until their typical bedtime when the lights were turned out. The women were awakened at their typical wake-up time.

Descriptive Characteristics

Demographic data collected included age in years, ethnic affiliations, marital status, level of formal education, type of work and job title, age when IBS pain began, and medication use. Body mass index (BMI) was computed based on the subjects' self-reported current height and weight.

Self-Reported Symptoms and Abuse

Abuse. The Childhood Trauma Questionnaire (CTQ) is a 28-item tool that asks about five types of maltreatment (emotional, physical, and sexual abuse, and emotional and physical neglect) during childhood and adolescence. The questions are rated from *never true* (1) to *very often true* (5). An example question for sexual abuse is "Someone tried to touch me in a sexual way or tried to make me touch them;" for physical abuse, "People in my family hit me so hard that it left me with bruises or marks;" and emotional abuse, "People in my family called me things like 'stupid,' 'lazy,' or 'ugly.'" Three items make up the minimization/denial scale for detecting false-negative trauma reports. The mean score for each scale is computed along with a threshold score for "caseness" (Bernstein et al., 1994). Confirmatory factor analyses and convergent validity supported the validity of the CTQ (Bernstein et al., 1994; Bernstein & Fink, 1998).

Daily symptom diary. Subjects completed a symptom diary that contained 26 symptoms, which were rated every evening. Each symptom was rated on a scale from 0 (*not present*) to 4 (*extreme)*. GI pain/discomfort symptoms in the daily diary included abdominal pain, abdominal distension, bloating, intestinal gas, heartburn, and nausea. GI symptoms related to stool characteristics were diarrhea, constipation, and urgency. While results are presented for individual GI symptoms, non-GI symptoms are combined into scales: somatic (headache, backache, joint, and muscle pain), anger (anger, hostility, and irritability), anxiety (anxiety, nervousness/jittery, and panic feelings), depression (decreased desire to talk or move, depressed/sad or blue, and hopelessness), cognitive difficulty (forgetfulness, hard to concentrate, hard to make decisions, and trouble with memory), and poor sleep (hard to fall asleep, waking up during the night, and waking up too early). Only participants who completed the daily diary were included in the analyses.

Sleep quality. The PSQI assesses sleep quality and disturbances over the prior month. It is composed of 19 items that are scored to determine seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Each component is scored from 0 to 3 and summed into a global PSQI score. Internal consistency of the PSQI score was reported as $\alpha = .83$ and test–retest reliability, with an average of 4 weeks between testing, was $r = .85$. A global PSQI score ≥ 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% ($\kappa = .75$, $p < .001$) in distinguishing good from poor sleepers (Buysse et al., 1989). In an additional validation study, a global PSQI score ≥ 6 was predictive of primary insomnia (sensitivity = 84%; specificity of 99%; Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002).

Physiological Measures

Sleep PSG. PSG recording included electroencephalography (EEG) to assess brainwaves, electromyography (EMG) to assess muscle tension, and electrooculography (EOG) to detect eye movements. The EEG was recorded from the C3-A2 and C4-A1 electrode placement (Heitkemper et al., 2005; Klem, Luders, Jasper, & Elger, 1999; Stiasny, Oertel, & Trenkwalder, 2002). Recordings were done using an Embla Recording

System with Somnologica software (Embla, Broomfield, Colorado). All records were prescreened for epochs with movement, breathing or muscle artifact, or recording difficulties; they were excluded from analysis. Sleep records were manually scored in 30-s epochs as wake, Stages 1, 2, 3, 4 (slow wave sleep), and 5 (rapid eye movement [REM]) by an experienced technician based on Rechtschaffen and Kales scoring criteria (Rechtschaffen & Kales, 1968). Inter-rater agreement was $\geq$90% for a random 10% of each sleep record.

HRV. Electrocardiogram (ECG) was recorded from a modified lead II, digitized with 16-bit amplitude resolution at 200 samples/s, which places a nominal constraint on the accuracy of the estimation of the individual RR interval lengths for HRV analysis to a resolution of about 5 ms. Interbeat intervals were summarized in successive 5-min blocks of normal sinus RR intervals and cross-linked with the manually scored PSG sleep-stage codes. A discrete Fourier transform (DFT-FFT) spectral analysis algorithm was used for the development of the HRV spectral measures. Time domain (statistical) HRV measures were computed based on RR intervals (normal interbeat intervals using the R-wave peak as the reference point measured in ms) and differences in RR intervals. Parasympathetic nervous system (PSNS) activity was assessed with spectral (Ln HF, natural log of the high frequency [HF] band power, $f =$ 0.15 to 0.40 Hz) and time domain (Ln RMSSD, natural log of the root mean square of successive differences in RR intervals) measures. Mixed sympathetic nervous system (SNS) and PSNS activity was measured with two time domain measures (Ln SD5min, natural log of the average standard deviation of RR intervals within all 5-min blocks; Ln SDNN, natural log of the standard deviation of RR intervals for the entire sleep interval) and a spectral measure (Ln LF, natural log low frequency [LF] band power, $f = 0.04$ to 0.15 Hz). SNS/PSNS balance was indexed in the frequency domain (square root LF/HF; Kleiger, Stein, Bosner, & Rottman, 1992; Ori, Monir, Weiss, Sayhouni, & Singer, 1992; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). HRV measures were computed by averaging over all of the 5-min blocks throughout Night 2.

Urine measures. Urine CA were measured by high-performance liquid chromatography (HPLC) after extraction by cation exchange (Bio-Rex 70, BioRad Laboratories) followed by alumina oxide precipitation using a modification of the LCEC Application Note No. 15 (Bioanal.Syst., 1982). Urine samples were preserved with Na_2EDTA and $Na_2S_2O_5$. Thawed samples were mixed with pH 6.5 phosphate buffer with 1% NaEDTA. For reliability, 1 ml samples were assayed in duplicate, using 1/5 the volume of solutions except for the perchlorate extraction of the CA from the alumni for which 200 µl was still used. The 10 µl samples in perchlorate were run through a Beckman Ultrasphere ODS 5 µm, 4.6 mm $\times$ 25 cm C-18 column using a Beckman autosampler, NECPC-8300 System Gold 116 solvent pump, and ESA 5100A Coulochem detector (guard cell, 0.35, detector 1; 0.05 and detector 2; $-$0.35 and gain of 25). Unknowns were determined from a standard curve made with three controls: clinical chemistry control I and II (Ciba Corning Diagnostics Corp.) and a urine pool (Bioanalytical Systems). The values of these standards were determined by standard addition curves for each CA with 3,4 dihydroxybenzamine as an internal standard. The intra-assay variation was <5% and the inter-assay variation was <9%.

Urine cortisol was measured by radioimmunoassay (RIA) using a kit from Diagnostic Products, Inc. (Los Angeles, California), involving dichloromethane extraction of steroids. Aliquots of sample were added to tubes coated with antibodies against cortisol, exposed to iodinated cortisol, and counted in a gamma counter. All assays were performed with duplicate samples and standards. The cortisol detection limit was 0.3 µg/dl and there was low cross-reactivity with other steroids. Inter- and intra-assay variations were 8.8% and 4.8%, respectively. Urine CA and cortisol were expressed per milligram of creatinine as well as body surface area. Creatinine was measured by an autoanalyzer technique with urine buffered to pH 2.3. Body surface area was estimated from height and weight tables.

Statistical Analysis

Since the focus of this report is the association of childhood abuse/neglect with symptom reports and physiological measures, all hypothesis test results shown relate to comparisons between the IBS with abuse/neglect and IBS without abuse/neglect groups. Summary statistics for the control without abuse/neglect group are also presented but for purely descriptive purposes.

Chi-square and *t* tests were used to compare the IBS with abuse/neglect and the IBS without abuse groups. Since age was strongly associated with abuse/neglect status in this sample, analysis of covariance (ANCOVA) and logistic regression were also used to compare the two groups, controlling for age. An alpha level of .05 was used for significance.

Results

Abuse

A total of 21 women with IBS reported a history of abuse/neglect and 19 women with IBS denied this history. The IBS abuse/neglect group included 16 women with a history of emotional abuse, 12 women with physical abuse, and 12 women who reported sexual abuse, with 6 women reporting all three types of abuse, 8 reporting only one type (4 emotional, 2 physical, and 2 sexual), and the remaining 7 reporting two types of abuse. None of the women in the IBS groups reported a history of physical neglect and all 10 of the women with a history of emotional neglect also reported some other type of abuse.

Women in the IBS with abuse/neglect and IBS without abuse/neglect groups did not differ on race (72% White), education (52% with a college degree), or job type (32% professional). However, compared to the 19 women in the IBS without abuse/neglect group, the 21 women in the IBS with

Table 1. Comparison of GI, Somatic, and Psychological Distress Symptoms in Women With IBS With and Without a History of Childhood Abuse and/or Neglect ($M \pm SD$)

Symptoms	Comparison, No Abuse ($n = 31$)	IBS, No Abuse/Neglect ($n = 17$)	IBS, Abuse/Neglect ($n = 21$)	P_1	P_2
GI					
Abdominal pain	0.21 ± 0.34	1.44 ± 0.65	1.41 ± 0.71	.909	.610
Bloating	0.39 ± 0.46	1.09 ± 0.79	1.26 ± 0.78	.518	.631
Constipation	0.12 ± 0.18	0.70 ± 0.48	1.02 ± 0.92	.204	.276
Diarrhea	0.06 ± 0.11	0.33 ± 0.30	0.43 ± 0.59	.520	.694
Intestinal gas	0.41 ± 0.45	1.63 ± 0.86	1.60 ± 0.77	.922	.865
Heartburn	0.05 ± 0.11	0.19 ± 0.35	0.58 ± 0.62	.028	.061
Nausea	0.08 ± 0.13	0.22 ± 0.22	0.53 ± 0.64	.035	.071
Somatic[a]	0.34 ± 0.39	0.56 ± 0.57	0.96 ± 0.57	.043	.099
Psychological distress					
Anger	0.44 ± 0.45	0.37 ± 0.23	0.80 ± 0.65	.013	.015
Anxiety	0.39 ± 0.39	0.44 ± 0.32	0.68 ± 0.60	.138	.232
Depression	0.39 ± 0.50	0.32 ± 0.29	0.75 ± 0.57	.007	.112
Cognitive difficulties	0.38 ± 0.39	0.65 ± 0.41	1.04 ± 0.65	.042	.145
Sleep problems	0.28 ± 0.39	0.27 ± 0.31	0.70 ± 0.80	.040	.078

Note. GI = gastrointestinal; IBS = irritable bowel syndrome. Comparison group comprised healthy women with no symptoms of a functional GI disorder. P_1 = unadjusted *p*-value, comparison of IBS with abuse/neglect to IBS without abuse/neglect only. P_2 = *p*-value controlling for age, comparison of IBS with abuse/neglect to IBS without abuse/neglect only.

[a] Somatic symptoms include headache, backache, and joint and muscle pain.

abuse/neglect group were older (mean 34.6 ± 7.9 vs. 28.4 ± 7.2 years, $p = .012$), had lower income (income > $40,000, 24% vs. 63%, $p = .024$), and were less likely to be married/partnered (19% vs. 47%, $p = .091$).

Symptoms

Daily GI symptoms. With the exception of heartburn and nausea, there were no significant group differences in GI symptoms between the IBS without abuse/neglect and IBS with abuse/neglect groups (Table 1). When used as a covariate, age reduced the significance of these differences. Note that the sample sizes in the table reflect the fact that three subjects (two IBS with abuse/neglect and one comparison) did not complete the daily diary.

Daily non-GI symptoms. Women in the IBS with abuse/neglect group reported significantly higher somatic symptom scores, though controlling for age reduces this significance. Similarly, the depression, cognitive difficulties, and poor sleep scales are worse in the IBS with abuse group, but the significance of these differences are greatly reduced by controlling for age. Anger is the only scale that is still significantly different after controlling for age. Figure 1 illustrates the confounding due to age differences between the IBS without abuse/neglect and IBS with abuse/neglect groups.

Sleep quality. Table 2 shows results on sleep quality, as measured both subjectively by self-report on the PSQI and objectively by PSG on Night 2 in the sleep lab. Similar to the sleep scale from the diary, women in the IBS with abuse/neglect group reported worse sleep on the PSQI. The PSQI global score became nonsignificant when age was controlled for; however, when dichotomized using either 5 or 6 as the cutpoint, the elevated prevalence of poor sleep in the IBS with abuse/neglect groups remained significant even after controlling for age. In contrast to the subjective reports of sleep quality, there was little difference between the IBS with abuse and the IBS without abuse/neglect groups on objectively measured sleep quality. The one exception is percentage of time in REM sleep, which was higher in the IBS with abuse group.

Sleep PSG. In contrast to the subjective reports of sleep quality, there was little difference between the IBS with abuse/neglect and the IBS without abuse/neglect groups on objectively measured sleep quality. The one exception was percentage of time in REM sleep, which was higher in the IBS with abuse/neglect group.

HRV. Women in the IBS with abuse/neglect group had higher nighttime heart rates (reduced RR intervals) when compared to those in the IBS without abuse group (Table 3). There was a trend for select indices of vagal modulation (LnRMSSD and LnSD5min) to be reduced in women in the IBS with abuse/neglect group as compared to those in the IBS without abuse group.

Urine measures. There were no significant differences in first-void urinary cortisol or CA levels (Table 4).

Discussion

A history of sleep disturbances is prevalent in patients, in particular women with IBS. In this study, data from a previous study (Heitkemper et al., 2005) were reanalyzed to examine childhood abuse/neglect as important factors contributing to poor sleep quality, arousal, and symptom severity in women with IBS. In the current analysis, approximately 50% of women

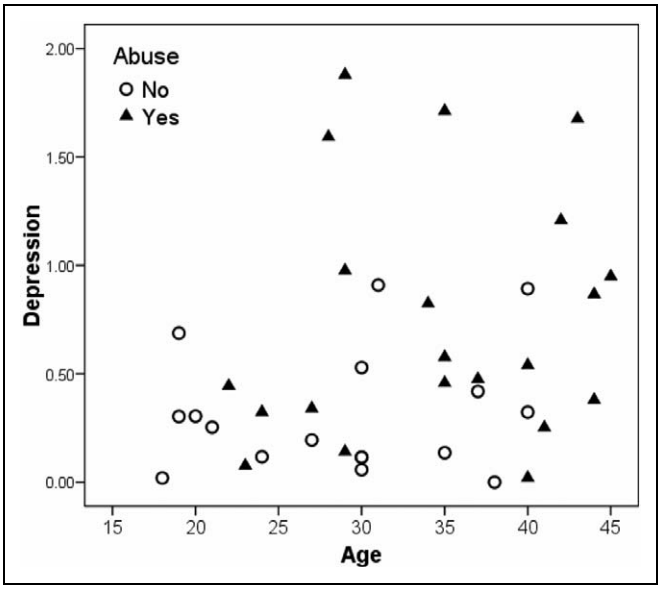

Figure 1. Scatterplot of average 4 daily depression symptom items (decreased desire to talk or move, depressed/sad or blue, hopelessness) rating for 28 days on a scale of 0, *not present*, to 4, *severe*, in women with irritable bowel syndrome (IBS) with a history of abuse/neglect ($n = 21$) and women with IBS without this history ($n = 17$).

in the IBS group reported that they had experienced some form of childhood abuse and/or neglect. This percentage of women with IBS and a history of abuse/neglect is comparable to that noted by other investigators (Chitkara et al., 2008; Delvaux et al., 1997; Drossman, 1997; Talley et al., 1998). The elevated prevalence of childhood abuse/neglect is also observed in other chronic conditions. Using the CTQ Tietjen noted that of 1,348 migraineurs (88% women), 58% reported some form of childhood abuse or neglect (Tietjen et al., 2010); 31% of this sample reported IBS as a comorbid condition. Other conditions prevalent in adult women such as chronic fatigue and fibromyalgia are also associated with early adverse events including abuse and neglect (Latthe, Mignin, Gray, Hills, & Khan, 2006; Leserman, 2006).

Interestingly in the current study, women with IBS who reported a history of childhood abuse/neglect were older than women with IBS who denied this history. This age-related difference in report of abuse is similar to the study by Tietjen et al. (2010) in which reports of all forms of childhood abuse (emotional, physical, and sexual) were greater in women with migraines above 40 years of age. Whether this is a cohort effect or it reflects an increase in the likelihood of reporting abuse with age is not known. In a Canadian telephone survey sample of men and women who experienced childhood sexual abuse ($n = 804$), Hebert and colleagues noted that while many reported experiencing childhood sexual abuse, most had not previously disclosed or had significantly delayed disclosing the abuse (Hebert, Tourigny, Cyr, McDuff, & Joly, 2009). In that survey, delayed disclosure was related to increased psychological distress. Additional studies are needed to examine the impact of abuse/neglect as well as its disclosure on the development and trajectory of chronic functional health problems.

One of the primary hypotheses of the current analysis was that women with IBS who reported a history of childhood abuse/neglect would also report higher levels of abdominal pain as well as GI discomfort symptoms (e.g., bloating) in the daily diary. This hypothesis was not supported. However, women with abuse/neglect did report more heartburn and nausea. Talley, using the Olmstead County, Minnesota, database (919 respondents), found that dyspepsia and heartburn were significantly associated with abuse (survey included any abuse—childhood or adult; Talley, 1994). The association of heartburn with history of abuse (any form) has been found in

Table 2. Objective and Subjective Sleep Variables in Women With IBS With and Without a History of Childhood Abuse and/or Neglect ($M \pm SD$, Unless Otherwise Noted)

Sleep Variable	Comparison, No Abuse/Neglect	IBS, No Abuse/Neglect	IBS Abuse/Neglect	P_1	P_2
Objective sleep	$n = 28$	$n = 17$	$n = 20$		
Time in bed (min)	448 ± 50	463 ± 48	444 ± 49	.251	.380
Total sleep time (min)	398 ± 54	409 ± 45	392 ± 53	.289	.640
Sleep efficiency index	0.89 ± 0.07	0.89 ± 0.06	0.88 ± 0.05	.829	.581
Sleep period efficiency index	0.92 ± 0.05	0.92 ± 0.05	0.91 ± 0.06	.535	.769
Fragmentation index	7.0 ± 2.2	6.8 ± 2.1	7.4 ± 2.5	.413	.863
Onset latency to Stage 2 (min)	18.2 ± 17.4	22.3 ± 15.9	16.8 ± 12.0	.239	.390
% time Stages 0 and 1	15.5 ± 6.7	15.0 ± 6.6	16.5 ± 7.3	.523	.876
% time Stage 2	46.4 ± 6.0	47.2 ± 7.0	46.3 ± 9.0	.733	.778
% time slow wave sleep	16.9 ± 8.4	17.3 ± 6.3	13.9 ± 6.4	.112	.416
% time in REM	21.1 ± 3.7	20.4 ± 3.4	23.2 ± 3.9	.026	.032
Subjective sleep	$n = 32$	$n = 19$	$n = 21$		
PSQI global	4.00 ± 1.7	5.00 ± 4.0	7.2 ± 2.8	.049	.087
PSQI global ≥5, *n* (%)	13 (41%)	8 (42%)	18 (86%)	.007	.012
PSQI global ≥6, *n* (%)	4 (12%)	5 (26%)	17 (81%)	.001	.002

Note. IBS = irritable bowel syndrome; PSQI = Pittsburgh Sleep Quality Index; REM = rapid eye movement. P_1 = unadjusted *p* value, comparison of IBS with abuse/neglect to IBS without abuse/neglect only. P_2 = *p* value controlling for age, comparison of IBS with abuse/neglect to IBS without abuse/neglect only.

Table 3. Comparison of HRV Indices in Controls and Women With IBS With and Without a History of Childhood Abuse and/or Neglect ($M \pm SD$)

HRV Index	Comparison, No Abuse/Neglect ($n = 28$)	IBS, No Abuse/ Neglect ($n = 17$)	IBS Abuse/ Neglect ($n = 20$)	P_1	P_2
Mean RR interval	905 ± 116	930 ± 108	844 ± 119	.028	.071
Square root LF/HF	1.44 ± 0.62	1.48 ± 0.70	1.54 ± 0.56	.753	.192
Ln HF	7.40 ± 0.69	7.53 ± 0.72	7.26 ± 0.61	.226	.704
Ln RMSSD	3.79 ± 0.59	3.84 ± 0.51	3.47 ± 0.47	.030	.325
Ln SD5min	4.13 ± 0.37	4.20 ± 0.27	3.93 ± 0.32	.008	.089
Ln SDNN	4.47 ± 0.31	4.53 ± 0.24	4.26 ± 0.30	.006	.041

Note. HRV = heart rate variability; IBS = irritable bowel syndrome; P_1 = unadjusted p value, comparison of IBS with abuse/neglect to IBS without abuse/neglect only; P_2 = p value controlling for age, comparison of IBS with abuse/neglect to IBS without abuse/neglect only; LF/HF = low frequency/high frequency; Ln HF = natural log of the high-frequency band power; LN RMSSD = natural log of the root mean square of successive differences in RR intervals; Ln SD5min = natural log of the average standard deviation of RR intervals within all 5-min blocks; LN SDNN = natural log of the standard deviation of RR intervals for the entire sleep interval.

Table 4. Urinary Cortisol, Norepinephrine, and Epinephrine Levels in Women With IBS With and Without a Childhood History of Abuse and/or Neglect ($M \pm SD$)

Variable	Comparison, No Abuse ($n = 29$)	IBS, No Abuse/Neglect ($n = 19$)	IBS, Abuse/Neglect ($n = 20$)	P_1	P_2
Cortisol μg/mg Cr	34.59 ± 16.33	27.85 ± 13.41	28.72 ± 14.98	.849	.669
Norepinephrine ng/mg Cr	19.66 ± 7.56	20.64 ± 8.97	22.06 ± 9.00	.626	.627
Epinephrine ng/mg Cr	1.70 ± 1.48	1.56 ± 0.92	1.57 ± 0.91	.976	.799

Note. Cr = creatinine; IBS = irritable bowel syndrome; P_1 = unadjusted p value, comparison of IBS with abuse/neglect to IBS without abuse/neglect only; P_2 = p value controlling for age, comparison of IBS with abuse/neglect to IBS without abuse/neglect only.

other populations as well (Van Oudenhove et al., 2008). In a laboratory study of gastric sensorimotor function in 223 patients with functional dyspepsia (84 with a positive history of abuse), Geeraerts and colleagues (2009) found that patients with a history of general and severe childhood sexual abuse had significantly lower thresholds for gastric distension measured with a barostat. In the current study, the report of heartburn and nausea by both groups of IBS patients was substantially lower relative to reports of abdominal pain and bloating. The diagnostic criteria for IBS involves the presence of abdominal pain and alterations in bowel pattern (diarrhea or constipation). As such, there may be a ceiling effect with regard to whether a history of childhood abuse can significantly influence abdominal pain or bowel symptom severity in this population.

Self-reports of sleep disturbances either in the daily diary or on the PSQI were greater in women with IBS who self-reported childhood abuse/neglect as compared to those who denied this history. The finding of difficulty getting to sleep and feeling unrefreshed upon awakening is similar to studies with other populations of patients who report childhood trauma (Abrams, Mulligan, Carleton, & Asmundson, 2008). Bader and colleagues (2007), in a study of primary insomniacs, found that individuals who reported high levels of adverse childhood events on the CTQ exhibited a significantly higher number of awakenings and increased movement (measured by actigraphy) and decreased sleep efficiency. This finding is consistent with the notion that childhood trauma may lead to hyperarousal. However, in the current study, despite significant differences in self-reported sleep quality between the IBS abuse/neglect and IBS nonabuse/neglect groups, only an increase in percentage of time in REM sleep and trends in other PSG variables were noted. Previously, in this sample (Heitkemper et al., 2005), we found that the primary IBS versus control group differences in PSG variables (increased REM latency) occurred on the first night (adaptation night) in the sleep laboratory only. The current analysis suggests that differences in REM sleep persist beyond the sleep laboratory adaptation night when the abuse/neglect group is compared with nonabuse/neglect subjects. The trend in decreased percentage of time in slow-wave sleep (Stages 3 and 4) in the IBS abuse/neglect group was reduced when age was used as a covariate.

GI and other visceral and somatic complaints and their relationships to traumatic childhood experiences remain to be fully characterized in women with IBS as well as in those with other functional and pathological conditions. Thurston and colleagues (2008) recently reported that hot flash severity and frequency in perimenopausal women is associated with a history of childhood abuse. There are a number of possible explanations for how early traumatic experiences may influence physiological and psychological states in adulthood. Animal studies reveal that exposure to stress during early developmental stages results in both visceral sensitivity as well as behavioral changes in adult animals (Chung et al., 2007; O'Mahony et al., 2009). Early adverse stressful events and

subsequent activation of the hypothalamic-pituitary-adrenal axis may modulate developing neural pathways associated with emotional regulation, cognition, and pain perception. Videlock and colleagues (2009) found increases in salivary cortisol in response to sigmoidoscopy in those who reported adverse childhood events (e.g., divorce, loss of a parent, or abuse); however, we found no differences in first-void urine CA and cortisol excretion in the IBS with abuse/neglect as compared to the IBS without abuse/neglect group. These contradictory findings suggest that differences in cortisol or other stress-related hormones such as norepinephrine and epinephrine may appear only when the individual is challenged with a stressor. In a small study of healthy women, Heim and colleagues (2000) found increased pituitary–adrenal and autonomic nervous system responses to emotional stressors in women who reported a history of sexual or physical abuse during childhood. However, in both that study and the current study, the results need to be interpreted cautiously due to sample sizes.

It has also been suggested that conditions such as IBS are associated with lower socioeconomic status, which has also been linked to vulnerability to adverse childhood events including abuse (Minocha, Johnson, Abell, & Wigington, 2006). Although over half of the women in the current study had a college degree, information on childhood environmental stressors such as socioeconomic status, loss of parents, and poverty were not measured. Additional early childhood events including low birth weight status and use of nasogastric suction at birth have also been identified as risk factors for the presence of IBS in adults (Rey & Talley, 2009). A case–control study design could perhaps address these issues. It is interesting to note that the majority of women over age 30 in the IBS with abuse/neglect group were unmarried and unpartnered.

Thus, for some women, IBS as well as other somatic problems may be viewed as long-term effects of early childhood traumatic experiences. Women in the IBS with abuse/neglect group reported on a daily basis higher levels of cognitive distress including forgetfulness, decreased ability to concentrate, and memory problems. In this young to middle-age population, these differences were only modestly affected when age was controlled. Since the presence of a severe psychiatric illness was an exclusion criteria, these results suggest that women in the IBS with abuse/neglect group found these cognitive symptoms more distressing than women with IBS and no history of abuse/neglect. There are reports that women with chronic fatigue syndrome and fibromyalgia similarly report problems with cognitive function (memory loss and difficult to concentrate; Leavitt & Kat, 2006; Verdejo-Garcia, Lopez-Torrecillas, Calandre, Delgado-Rodriguez, & Bechara, 2009). One challenge is to determine whether these cognitive symptoms are due to premorbid states such as mood states, chronicity of illness, and/or chronic pathophysiologic processes. A recent small-sample study found decrements in verbal IQs in individuals with IBS ($n = 29$), and even larger decrements in individuals with inflammatory bowel disease, compared to healthy controls (Dancey, Attree, Stuart, Wilson, & Sonnet, 2009). Again, further work is needed to clarify whether mild cognitive impairments are more prevalent in patients with chronic recurring health conditions such as IBS.

The current study revealed differences in nocturnal HRV between the two groups. However, indices of vagal tone were affected by age. HRV, and in particular vagal tone, decreases in both men and women with age (Cowan, Pike, & Burr, 1994). Even in our sample's relatively narrow range of age, increasing age was associated with reduced indices of HRV. There is evidence from prior researcher that childhood abuse is associated with autonomic dysfunction as well as posttraumatic stress disorder in adults (Keary, Hughes, & Palmieri, 2009; Zucker, Samuelson, Muench, Greenberg, & Gevitz, 2009). The question remains as to whether abuse directly influences the PSNS during a period of development thus setting the stage for decreases in HRV across the life span. An alternative hypothesis would be that reductions in HRV as a result of gene–environment interactions predispose individuals to functional problems such as IBS. In the current sample, we previously demonstrated IBS bowel pattern subgroup (diarrhea vs. constipation) differences in HRV as well as nocturnal blood levels of norepinephrine and epinephrine on the third night in the laboratory (Burr et al., 2009). When abuse history was controlled, HRV differences between these bowel pattern subgroups was not affected.

Clinical Implications

The higher rate of abuse and neglect reported by women with IBS supports the importance of gathering information regarding childhood adverse events in clinical settings using a sensitive and perhaps standardized method. The tool used in the current study may not be adequate to capture the range of adverse events that can happen during childhood. Understanding the context of women's lives will also help in the exploration of gene–environment factors.

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