Published in final edited form as:
J Psychosom Res. 2013 June ; 74(6): 493–500. doi:10.1016/j.jpsychores.2013.03.009.

Negative Aspects of Close Relationships are More Strongly Associated than Supportive Personal Relationships with Illness Burden of Irritable Bowel Syndrome

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Abstract

OBJECTIVE—This study assessed the relative magnitude of associations between IBS outcomes and different aspects of social relationships (social support, negative interactions).

METHOD—Subjects included 235 Rome III diagnosed IBS patients (M age = 41 yrs, F=78%) without comorbid GI disease. Subjects completed a testing battery that included the Interpersonal Support Evaluation List (Social support or SS), Negative Interaction (NI) Scale, IBS Symptom Severity Scale (IBS-SSS), IBS-QOL, BSI Depression, STAI Trait Anxiety, SOMS-7 (somatization), Perceived Stress Scale, and a medical comorbidity checklist.

RESULTS—After controlling for demographic variables, both SS and NI were significantly correlated with all of the clinical variables (SS r's = .20 to .36; NI r's = .17 to .53, respectively; ps < .05) save for IBS symptom severity (IBS-SSS). NI, but not SS, was positively correlated with IBS-SSS. After performing r-to-z transformations on the correlation coefficients and then comparing z-scores, the correlation between, perceived stress, and NI was significantly stronger than with SS. There was no significant difference between the strength of correlations between NI and SS for depression, somatization, trait anxiety, and IBSQOL. A hierarchical linear regression identified both SS and NI as significant predictors of IBS-QOL.

CONCLUSIONS—Different aspects of social relationships -- support and negative interactions -- are associated with multiple aspects of IBS experience (e.g. stress, QOL impairment). Negative

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Conflicts: None to report

social relationships marked by conflict and adverse exchanges are more consistently and strongly related to IBS outcomes than social support.

Keywords

interpersonal interactions; social networks; social support; health; comorbidity; pain; coping

Irritable bowel syndrome (IBS) is a common, potentially disabling gastrointestinal (GI) disorder characterized by abdominal pain associated with altered bowel habits (e.g., diarrhea, constipation, or both in an alternating manner). With a prevalence rate of 10-20% in developed countries[1], IBS is one of the most common illnesses seen in primary care and GI practices [2]. Because IBS symptoms are painful, emotionally bothersome, intrusive and mimic symptoms of organic GI diseases, IBS results in significant direct (e.g. use of healthcare-related services such as physician visits, diagnostic tests, and prescription or over the- counter medication) and indirect (work absenteeism, diminished quality of life) costs to patients, the health care industry, and employers [3].

Lacking a reliable biomarker, IBS is best understood from the perspective of a biopsychosocial model [4] that emphasizes the reciprocal and interactive influences of biological, environmental, and psychological processes. Of psychosocial factors, stress exerts an enduring and robust impact on various aspects of IBS [5]. One way that stress influences IBS is by increasing risk of symptom onset. One example comes from research [6] of patients who develop IBS after a bout of infectious gastroenteritis (i.e. post infectious IBS or PI-IBS). While most patients rapidly recover from bacterial gastroenteritis, up to a third of patients experience persistent GI symptoms with a portion of those affected meeting diagnostic criteria for IBS [7]. The onset of stressful life events within three months of the infectious illness represents a major risk factor for developing IBS-PI. A close inspection [8, 9] of the type of stressful life events that occur in close temporal proximity to the bacterial infection in individuals who subsequently develop PI-IBS [6]suggests a high frequency of adverse changes in social relationships such as the death of a loved one, disagreements with supervisor, or the end of a marriage.

The notion that negative aspects of social relationships influence health outcomes is a growing area of investigation[10] After all, humans are social creatures who have an inherent biological need to form and maintain strong, stable, and positive relationships [11], which exposes them to periods of distress when interpersonal encounters take on a tone of conflict, rejection, criticism or intrusiveness. There is considerable research linking negative interactions to psychological well-being [12]. Much less is known about the adverse effects of negative interactions on physical health outcomes [13].

IBS represents an ideal disease state to study the relationship between negative social exchanges and physical health. As noted above and elsewhere there is suggestive evidence that IBS patients are reactive to interpersonal stressors [8, 9], and psychological treatments [14] that systematically help the patient resolve their interpersonal problems yield improvement in GI symptoms. IBS is more common among women [15] and women are more likely to experience negative aspects of close relationships [16]. They are more likely to be sensitive to negative social interactions and invest more time and energy in social relationships than men [17-19]. Despite having more close relationships and receiving and giving more support than men, women report higher negative interactions and psychological distress [20]. Interactions that are a source of discord and tension can function as a potent source of stress which if persistent can aggravate GI symptoms by dysregulating brain-gut interactions. In this respect, we would expect that IBS patients who report more negative social exchanges would report more severe IBS symptoms. Because social relations form a

conduit for the exchange of support, they do not necessarily have deleterious effects on health outcomes. Indeed, supportive relationships can protect individuals from a multitude of health problems and the absence of supportive relationship can increase the risk of serious health outcomes [21, 22]. In the case of IBS, Lackner et al [23] found that social support was inversely related to global IBS symptom severity, abdominal pain, and perceived stress in IBS patients. The researchers found cross sectional data consistent with a stress buffering effect of social support (i.e. support mitigates against the potentially adverse impact of stressful events on abdominal pain which is regarded as cardinal symptom of IBS). The effect of stress on pain was lessened for those IBS patients with stronger support systems. Psychological stress had more pronounced effect on pain for those with limited support. Levels of perceived support were unrelated to quality of life impairment.

Thus there are conceptual and empirical reasons to believe that both negative and positive aspects of social relationships are associated with physical health problems in IBS patients. A natural extension of these two lines of research is to determine whether IBS outcomes are more strongly associated with the positive or negative aspects of social relationships. This is an important issue that may help identify interactional patterns that, if targeted, can improve the quality of relationships in important networks (e.g., physician-patient) that influence the physical health and well-being of IBS patients whose symptoms are unresponsive to standard medical treatments. While most of health research has focused on the beneficial aspects of social relationships (e.g., social support), there is reason to believe that negative interactions may have more explanatory value. Negative exchanges have been found to more strongly relate to well-being than positive exchanges. In research with the elderly, Rook et al [24] refers to this phenomenon as the “negativity effect”. Whether the ‘”negativity effect” extends to a younger population of mostly female individuals with functional GI disease is unclear. The primary purpose of this study was to assess the relative magnitude of the association between the severity of somatic complaints and positive vs. negative components of social relationships in a sample of severely affected IBS patients recruited from two academic medical centers as part of an NIH funded clinical trial. Secondary goals were to study the association between the quality of social relationships and other aspects of IBS experience including distress (anxiety, depression), quality of life impairment due to IBS symptoms, and extraintestinal problems including number of comorbid medical disorders and medically unexplained symptoms (somatization).

Method

Participants

Participants included 235 consecutively evaluated IBS patients recruited primarily through local media coverage and community advertising and referral by local physicians to a tertiary care center at an academic medical center. To qualify, participants must have met Rome III IBS diagnostic criteria [25] without organic gastrointestinal disease (e.g., IBD, colon cancer, etc) as determined by a board-certified study gastroenterologist. Rome criteria define IBS as recurrent abdominal pain or discomfort at least 3 days per month over the last 3 months that is associated with at least 2 of the following: 1) improvement with defecation, 2) onset associated with a change in stool form, or 3) onset associated with a change in the frequency of stool[26]. Because this study was conducted as part of a clinical trial for moderate to severely affected patients with IBS, participants must have also reported IBS symptoms of at least moderate intensity (i.e., symptom occurring at least twice weekly for 6 months and causing life interference). Exclusion criteria were: presence of a comorbid organic GI disease (e.g., IBD) that would adequately explain GI symptoms; mental retardation; current or past diagnosis of schizophrenia or other psychotic disorders; current diagnosis of unipolar depression with suicidal ideation; current diagnosis of psychoactive substance abuse. Institutional review board approval and written, signed consent were

obtained before the study began. This study was completed in full compliance with the Declaration of Helsinki.

Procedure

After a brief telephone interview to determine whether participants were likely to meet basic inclusion criteria, participants were scheduled for a medical examination to confirm IBS diagnosis [25, 27] and psychometric testing, which for the purposes of this study included the test battery described below.

Measurement Methods

IBS Symptom Severity—The Irritable Bowel Syndrome Symptom Severity (IBS-SSS; Francis, Morris, Whorwell, 1997) is a 5-item instrument used to measure severity of abdominal pain, frequency of abdominal pain, severity of abdominal distension, dissatisfaction with bowel habits, and interference with quality of life, each on a 100-point scale. For four of the items, the scales are represented as continuous lines with endpoints 0% and 100%, with different descriptors at the endpoints and adverb qualifiers (e.g., “not very,” “quite”) strategically placed along the line. Respondents mark a point on the line between the two endpoints reflecting the extremity of their judgment. The proportional distance from zero is the score assigned for that scale (hence scores range from 0 to 100). The endpoints for the severity items are “no pain” and “very severe,” for satisfaction, the endpoints are “not at all satisfied” and “very satisfied,” and for interference they are “not at all interferes” to “completely interferes.” A final item asks the number of days out of 10 the patient experiences abdominal pain and the answer is multiplied by 10 to create a 0 to 100 metric. The items are summed and thus the total score can range from 0 to 500.

Quality of Life—The IBS-QOL [28] is a 34-item measure constructed specifically to assess quality of life impairment due to IBS symptoms [29]. Each item is scored on a five-point scale (1 = not at all, 5 = a great deal) that represents one of eight dimensions (dysphoria, interference with activity, body image, health worry, food avoidance, social reaction, sexual dysfunction, and relationships). Items are scored to derive an overall total score of IBS related quality of life. To facilitate score interpretation, the summed total score is transformed to a zero to 100 scale ranging from zero (poor quality of life) to 100 (maximum quality of life). The psychometric properties of IBS QOL are well established [28]

Perceived Stress Scale (PSS)—The PSS measures the degree to which situations in one’s life are appraised as stressful [30]). The 4 item version of the PSS [31] was used. Its items are designed to tap the degree to which respondents find their lives uncontrollable, unpredictable, and overloading. These three factors have been consistently found to be central components of the stress experience. Item are rated on a 5 point Likert scale ranging from 0 (never) to 4. In prior research, high scores on the PSS have been associated with poorer health and more health service utilization[31].

Abdominal Pain—Abdominal pain intensity over the previous 7 days was measured with an 11-point numerical rating scale (PI-NRS), where 0=no pain and 10=worst possible pain [32]. Patients circled the number from 0-11 that best described their average abdominal pain over the past 7 days.

Depression—Depressive symptoms were measured using the depression scale of the 18 item version of the Brief Symptom Inventory [33]. The scale include 5 items rated on a 5 point scale (0- not at all, 1, a little bit, 3 = quite a bit, 4 = extremely) to reflect respondents

distress about depressive symptoms (e.g., feeling lonely, blue, worthless, hopeless) The BSI is a psychometrically sound measure that has been used extensively in IBS research [34]

Somatization—Somatization was measured using the Screening for Somatoform Symptoms-7 [SOMS-7, 35] The SOMS includes a total of 53 physical symptoms, drawn from the DSM-IV [36] and the International Classification of Diseases (ICD-10) definitions for somatization disorder and somatoform autonomic dysfunction. Subjects are instructed to report only complaints for which physicians have found no currently physical pathological cause. Respondents are asked to report the symptoms that have been present during the past 7 days. The total number of endorsed symptoms yields a somatization symptom count which has been found to discriminate patients with somatoform disorders from those with other forms of mental disorders.

Anxiety—Trait anxiety was measured using the abbreviated Trait subscale of the STAI [37]. In responding to the 10 items of the T-Anxiety scale, subjects indicate how they generally feel by rating the frequency of their feelings of anxiety on a 4-point scale ranging from 1 (almost never) to 4 (almost always). The trait scale of the STAI has sound psychometric properties (e.g., internal consistency, stability, validity) [38]

Negative interactions—The Negative Interactions Scale (NIS) assesses social encounters and interactions that are characterized by conflict, excessive demands and/or criticism (30, 31). Our version of the NIS includes 5 items that assess the frequency (ranging from 1 = never to 4 = very often) of negative social exchanges with a spouse, family members, friends, neighbors, in-laws. The scale includes four items from the original 4-tem scale developed and validated by Krause and one additional item drawn from Schuster, Kessler, & Aseltine [39] (“How often do they let you down when you are counting on them?”) and used in the MIDMAC (MacArthur Foundation Research Network on Successful Midlife Development). Participants were asked “In the past month, how often have others…” about exchanges such as “… made too many demands on you?”, “…been critical of you?”, “… pried into your affairs?”, “…taken advantage of you?” and “…let you down when you were counting on them?” High scores suggest that respondents engage in negative interactions more frequently. The five item NIS is part of the assessment battery for social/ environmental burdens of the Pittsburgh Mind Body Center, a joint research project of the University of Pittsburgh and Carnegie Mellon University.

Social Support—The short form of the Interpersonal Support Evaluation List (ISEL-SF[40, 41]) consists of a list of 12 statements concerning the perceived availability of three discrete functions of social. The items fall into three four-item subscales. The “tangible” subscale is intended to measure perceived availability of material aid (e.g., “if I got stranded 10 miles out of town, there is someone I could call to come get me”); the “appraisal” subscale, the perceived availability of someone to talk to about one’s problems (e.g., there is *at least one person* I know whose advice I can really trust”); and the “belonging” subscale, the perceived availability of people one can do things with (“there are several different people with whom I enjoy spending time”). A total score of all items (after reverse coding 6 items) yields an index of the patient’s general perception of social support. Items are rated on a four-point scale with anchors ranging from “definitely true” to “definitely false.” The ISEL has excellent internal consistent and good test-retest reliability[42]. Availability of social support has been linked to physical health outcomes [43] and improved psychological state[44].

Medical Comorbidity—Medical comorbidity was assessed using a modified version of the survey used in the National Health Interview Survey (NHIS) to record the recency of

commonly occurring chronic conditions believed to be associated with substantial quality of life impairment [45]. We have adapted the NHIS checklist to characterize physical comorbidity of IBS patients in three NIH funded clinical trials [46]. The current version [47] covers 112 medical conditions organized around 12 body systems (musculoskeletal, digestive, kidney/genitourinary, endocrine, respiratory, circulatory, cardiovascular, oral, CNS, dermatological, Ear Nose, Throat [ENT], cancer). Respondents were asked whether a doctor had ever diagnosed them with a condition and, if so, whether the condition was present in the past 3 months. Persons were counted as current cases if the diagnosed condition was reported as present in the last 3 months. The checklist was constructed to capture information about the most common comorbidities in the general population, those believed to occur frequently in IBS patients, those regarded as most important to IBS patients, and those regarded as most important in existing comorbidity measure [48]. A total comorbidity score was based on the number of medical comorbidities a patient reported as present over the previous 3 months.

Data Analyses Plan

Data analyses were carried out in three steps. The first step was to characterize the sample using means, standard deviations or percentages. Additionally, although our primary interest is exploring the linear relationships between social interaction variables and the other clinical/outcome variables, we also wanted to determine if there would be differences (and if so, how different) among different levels (i.e., groupings) of social interaction variables. To do so, we divided the patients' negative interactions and social support scores into quartiles and compared each of the subsequent group's mean scores on the clinical/outcome variables (within each social interaction variables) using ANOVA. If the omnibus test for any variable was significant, we conducted post-hoc tests using a Bonferroni correction for multiple comparisons.

At the second step, we conducted partial correlations to describe the relationships among the social relationship variables, IBS symptom variables, psychological variables, and non-GI somatic variables after holding constant potentially confounding variables including age, education, income, marital status, IBS subtype, and duration of symptoms. Because correlations do not account for overlap among variables, the third step involved a series of multiple regression analyses to determine if a significant proportion of the variance in IBS quality of life and IBS symptoms was accounted for by the social relationship variables after controlling for demographic, psychological and non-GI somatic variables. All alpha levels were set at $p < .05$. All data analyses were performed using SPSS version 19.0 (SPSS, 2010).

Results

Characteristics of the sample

Table 1 displays the demographic and clinical characteristics of the sample. The mean total score on the IBS-SSS for the sample was 285.2 which falls in the high moderate range of IBS symptom severity (moderate = 176-300; severe > 300). Patients' average abdominal pain intensity for seven days prior to testing was 5.0 using an 11-point numerical rating scale (0 = No Pain, 10 = Worst Pain Possible). Patients with a mean of 56.5 on the IBSQOL are regarded as having significant quality of life impairment due to IBS symptoms[49].

Patients also reported an average of almost eight (7.8) medical conditions other than IBS. The median number of medical comorbidities was slightly lower (6.0) and the most reported number of medical comorbidities (ie., mode) was two. The most common self-reported

comorbidities included allergies (36%), gastroesophageal reflux (GERD, 28%), low back pain (23%), insomnia (21%), and migraine headache (19%).

With respect to psychosocial variables, anxiety was the most predominant emotional state reported by the sample. The mean trait anxiety score (20.5) fell at the 75th percentile, meaning that patients scored, on average, higher than 75th percent of other individuals completing the short form of the STAI-Trait. A raw score of 4.5 on the BSI-Depression scale, on the other hand, corresponded with a percentile rank of 56 *[33]*. Nineteen percent of the sample reported depressive scores that were clinically significant (BSI-Depression T score ≥ 63). Regarding social relationships, patients scored an average of 10.1 (S.D. = 3.2) on the NIS (total scores range from 5 to 20). Seventy-seven of the participants had a score between 7 and 13 and there was a moderate positive skewness to the distribution of scores (. 81). To control for possible effects of skewness, all analyses involving the NIS were run with the raw NIS data and then with log-transformed data, which serves to normalize skewed distributions [50]. Given that results using the log-transformed data did not significantly differ from those using the raw data, we will only report results from analyses using the raw data.

Differences in levels of social interactions

The results of the ANOVAs are shown in Table 2a and 2b. With a few exceptions, those patients whose negative interactions scores were in the first, second, or third quartile scored similarly to one another on all measures (Table 2a). Patients in the fourth quartile (i.e., most negative interactions) consistently scored significantly worse than all of the other patients across all measures, except for symptom severity and number of comorbid medical complaints where they scored statistically similar to patients in the third quartile. This suggests that patients with very severe and frequent negative social exchanges are more likely to experience psychological and physical problems than those patients with even a moderate amount and number of negative interactions. In contrast, there were no statistically significant differences between any of the social support quartile groups on symptom severity and abdominal pain (Table 2b). On most other measures (perceived stress, depression, trait anxiety, and number of medical comorbidities), the first and second quartile groups collectively differed from the third and fourth percentile groups. st and 2nd quartiles) These data suggest that while patients with lower levels of social support (1may experience increased distress (stress, depression, anxiety), IBS symptom severity (IBS-SSS, abdominal pain) was more widely distributed across multiple levels of social support.

Associations between social relationship variables and clinical variables

We conducted a series of partial correlations to assess the magnitude of the association between social relationships and clinical variables while controlling for possible confound variables (e.g., demographics, duration of IBS, gender, etc). As shown in Table 3, all significant correlations were in the expected manner. Of the three IBS symptom variables (i.e. abdominal pain, IBS-SSS, IBS-QOL), only IBS-QOL was cross-sectionally correlated with both negative interactions ($r=-.29$, $p<.05$) and social support ($r=.27$, $p<.05$). Individuals with poorer social relationships had worse quality of life due to IBS symptoms. Negative interactions, but not social support, were significantly, albeit modestly, correlated with both global symptom severity ($r=.17$, $p<.05$) and abdominal pain ($r=.20$, $p<.05$).

All three psychological variables (i.e. anxiety, depression, and perceived stress), were significantly correlated with both negative interactions and social support. Negative interactions were positively associated with anxiety ($r=.47$, $p<.05$), depression ($r=.45$, $p<.05$), and stress ($r=.53$, $p<.05$). Social support was negatively associated with anxiety ($r=-.37$, $p<.05$), depression ($r=-.39$, $p<.05$), and stress($r=-.36$, $p<.05$). These data suggest that

those patients with worse social relationships experience a range of psychological distress problems.

With respect to non-GI somatic variables, both somatization and medical comorbidity were significantly correlated with negative interactions and social support. Negative interactions were positively associated with somatization ($r = .27$, $p < .05$) and comorbidity ($r = .26$, $p < .05$), while social interactions were negatively associated with somatization ($r = -.17$, $p < .05$) and comorbidity ($r = -.19$, $p < .05$). The magnitude of the relationship between negative interactions and extraintestinal complaints was larger than the correlations with low support.

Additionally, we wanted to determine whether the magnitude of the correlations between the social relationship variables and the clinical variables were statistically significant. To do so, we performed a set of r-to-z transformations on the correlation coefficients and subsequently compared z-scores for each clinical variable that was statistically significant for both social support and negative interactions. Only the correlation between perceived stress and negative interactions was statistically greater than the correlation between stress and social support ($z = 2.3$, $p < .05$). Correlations between the two dimensions of social relationships and depression, somatization, and trait anxiety did not statistically differ.

Regression analyses

In order to determine whether negative interaction or social support was a better predictor of outcome variables (IBS-QOL, IBS symptom severity) while controlling for other demographic and clinical variables, we planned on doing hierarchical linear regressions for each outcome variable. However, because social support was not significantly correlated with IBS symptom severity, we only conducted the analysis for IBS-QOL.

For the regression model, all of the clinical variables were entered as independent variables as all were significantly correlated with IBS symptom severity. We also assessed multicollinearity statistics [variance inflation factors (VIF) and tolerance] for the regression analyses because of the strong correlations among many of the predictor variables. Although multicollinearity would not affect the reliability of the whole regression model or blocks of variables entered, it would call into question the validity of the results of individual predictors. The results showed that the highest VIF was 2.43 and the lowest tolerance value was .38, suggesting that multicollinearity did not compromise the interpretability results of the present study with all values well within an acceptable range.

Demographic variables were entered into the regression equation in the first step; clinical variables were entered in the second step; and the third step introduced the social relationship variables (negative interactions, social support) variables. Entering the variables in steps allows us to determine the incremental variance attributed to each conceptually distinct block of variables. The results of the regression analyses are shown in Table 4. In step 1, being older and more educated (were significantly related to better quality of life. As a set, these variables accounted for 10.5% of the variance in quality of life ($F = 4.30$, $p < .01$). In Step 2, the clinical variables explained an additional 18.4% of the variance in quality of life. Somatization (, trait anxiety, and perceived stress emerged as significant predictors of quality of life at step 2. Finally, the addition of the social relationship variables into the model explained an additional 12.4% of the variance in quality of life ($F = 5.08$, $p < .01$), which means that the final accounted for 41.3% of the variance. Both negative interactions ($\beta = -.19$, $t = -2.33$, $p < .05$) and social support ($\beta = .18$, $t = 2.01$, $p < .05$) proved to be significant predictors suggesting that both contribute somewhat equally to explaining the variance in quality of life scores. In addition, somatization, trait anxiety, and perceived stress were also significant predictors. The proportion of variance accounted for by age, and education was no longer significant in the final model.

Discussion

The main aim of this study was to assess the relative magnitude of the association between IBS symptoms and two aspects of social relationships (negative interactions, social support) in a sample of severely affected IBS patients. We found that both low social support and negative interactions were associated with greater stress and quality of life impairment due to IBS symptoms. Patients who described their life as unpredictable, uncontrollable, and overwhelming (i.e. high perceived stress) reported more negative exchanges and lower levels of support than patients who perceived their lives as less stressful. Secondary correlation analyses using r-t- z transformation suggest that negative interactions is a more robust source of psychological stress than low support.

Similarly, patients who reported worse quality of life due to IBS symptoms reported more unpleasant encounters and lower support. Taken together these two findings tie the quality of the social relationships to the psychological burden of IBS. These data echo findings from other researchers linking who have found that the quality of social relationships has an important effect on psychological well-being and distress [51].

Of the two aspects of social relationships, however, only negative interactions were statistically associated with more severe IBS symptoms. Patients who described their exchanges as fraught with more conflict, excessive demands, and/or criticism reported worse IBS symptoms. These data echo the work of Gerson et al who found that conflictual (family) relationships corresponded with worse IBS symptoms [52]. In this study.,patients with low support did not report significantly more severe IBS symptoms than patients with greater support. While the correlations between negative encounters and IBS symptoms were modest and must be interpreted cautiously, it is worth speculating about why negative exchanges may be more strongly associated with IBS symptoms. According to Room and Pietromonaco [53], positive social interactions occur more frequently than negative ones, which creates an expectation that interactions will be positive. Negative social exchanges “may shatter these expectations and stun the recipient” (p. 1006) resulting in periods of symptom aggravating distress. De Vogli et al [16] contends that negative encounters have a more powerful impact on physical health than positive social ties “because of the power of negative close relationship to activate stronger emotions (worrying and anxiety) and consequent physiological effects”(p 1955). Heightened physical and cognitive arousal may disrupt brain-gut interactions and aggravate IBS symptoms.

The finding that social support was unrelated to IBS symptoms is at odds with previous research which found that low social support was related to abdominal pain and global IBS symptom severity[23]. It is possible the difference is these findings relates to measurement differences between the two studies. While the social support measures in both studies tapped into perceived availability to social support, the measure used in our 2010 study (Multidimensional Scale of Perceived Social Support[54]) includes items gauging perceived adequacy of social support. It is possible that the adequacy of social support is clinically important dimension of social support for IBS patients. The general pattern of findings linking negative interactions with IBS symptoms is in step with broader health literature that has found a consistent link between the quality of social relationships and physical health [10]. A recently published meta-analysis of 148 trials including over 300,000 subjects found that stronger social relationships was associated with an approximately 50% lower risk for future mortality that cut across different causes of death[55]. In fact, evidence linking social relationships to mortality was comparable to standard risk factors such as smoking and physical activity. Against the backdrop of these and other findings linking social support and physical health, it is surprising that the current study is to our knowledge the first one relating negative social exchanges to the severity of IBS symptoms. Two previous studies

[8, 56] investigated the interpersonal difficulties of IBS patients but did not explicitly link them to IBS symptoms. We would have expected a larger body of research particularly given the importance IBS researchers have attached to the quality of the physician-patient relationship [57]. So established is the importance of interpersonal processes that practice guidelines emphasize the provision of emotional support (by increasing capacity for empathy and interpersonal sensitivity) as a way of optimizing therapeutic outcomes including "patient satisfaction, adherence to treatment, symptom reduction" [57, p. 1382]. Enhancing the supportiveness of health care professionals undoubtedly has therapeutic benefits but these benefits may not necessarily include fewer negative encounters. Social relationships are quite complex and a single social relationship can be both a source of support and distress [58]. Positive and negative social exchanges are orthogonal dimensions that can have quite different effects on health outcomes [12, 59]. One example comes from McCaskill and Lakey [59] who found that social support was primarily associated with positive affect, while negative social encounters were primarily related to negative affect. These and other data suggests that systematic efforts to increase support may not necessarily reduce negative interactions. A physician for example can provide a level of support that under some conditions has a very real, positive impact on the well-being of his/her patients. In other circumstances, the same physician may engage in negative and unhelpful comments from the patient's perspective. A relationship that contains both positive and negative qualities can interfere with effective support and can become a chronic source of interpersonal stress in its own right[60]. The worry, hypervigilance, reactivity [61, 62] emanating from "ambivalent" relationships (i.e., those that contain both positive and negative exchanges) can aggravate complaints and overwhelm coping resources required for chronic disease management [63, 64]. Future research is needed to understand the interplay of both positive and negative aspects of valued relationships as they relate to IBS outcomes and their underlying psychological and biological mechanisms.

Advances in this area may require more fine grained assessment approaches that target the specific relationship properties in the social network that has greatest influence over health outcomes. We chose to focus on the quality of relationship with family, friends, and neighbors in part because this network is the source of one of the most upsetting stressors that people experience[65]. Even infrequent negative interactions in this network can exert an adverse impact on both physical and mental health outcomes [66, 67]. Whether the quality and impact of these relationships generalize to other networks (e.g., health care) is unclear and an important area of future investigation. Previous research [29] indicates that there is considerable situational consistency in negative interactions (i.e. individuals who encounter interpersonal problems in one situation (e.g., friends) tend to encounter them in other situations (e.g., family)). It is unclear whether the consistency of negative encounters with family and friends extends to other relationship such as medical professionals. Systematically assessing the interaction patterns that play out between patient and physician (and other health care professionals including primary care physician, nurse, physician assistant, et al) may help define what is meant by a quality therapeutic alliance. This information can then be used to design more effective strategies that teach patients how to elicit more effectively support from their health care team and how providers can maximize their support potential by preventing negative exchanges or to minimize their adverse psychological impact..

A novel aspect of this study is the finding relating the quality of social relationships to extraintestinal complaints as measured by the number of medically unexplained symptoms (somatization) and physician-diagnosed medical comorbidities. Comorbidity has emerged as a major clinical, public health, and research issue over the past 20 years[68]. It is an important clinical issue because comorbidity may delay accurate diagnosis, influence clinical decision making, and complicate patient presentation of chief complaints.

Comorbidity is particularly problematic in IBS problem because of its prevalence [69] and cost at both personal and economic [70] level. Generally speaking, comorbidity researchers have focused on the nature and pattern of coexisting medical disorders of patients with a specific index disorder. Little is known about how illness modifying factors (e.g., the quality of social ties, coping strategies, appraisal) influence comorbid conditions. We are not inclined to believe that that the effect that social relationships have on physical health is limited to the index problem for which patients seek treatment. We are more likely to think its reach extends to other coexisting disorders that make up the patient's total illness burden. Coping effectively with the mental and physical challenges of a chronic illness requires considerable support and guidance from others. For physically ill patients, obtaining the level of support to meet their needs is often difficult because they often face a range of unsupportive reactions ranging from minimization and forced cheerfulness to avoidance and outright rejection[71]. Negative encounters with others are likely to function as potent stressors that undermine the ability to cope with the day to day burden of medical comorbidity. One may reasonably expect that such negative encounters are likely more frequent and impactful for patients afflicted with multiple medical disorders. In our cohort, IBS patients reported an average of almost eight medical comorbidities. One factor that may heighten interpersonal stress is not only the number of medical comorbidities but their type and duration. Many of the most common medical comorbidities our patients reported were characterized by persistent pain (e.g., low back pain, TMJ, headache). These disorders are likely to cause "wear and tear" of resources within patients' social network [72]. If pain and suffering persists indefinitely without relief, members of social network may find supporting the needs of a patient increasingly frustrating and difficult to meet [73, 74]. Further research that extends the stress and coping paradigm to the problem of comorbidity is needed.

These data should be interpreted in light of a number of study limitations. Because our data are cross sectional and correlational, we do not intend to suggest that findings demonstrate causal relationships among social relationships and IBS outcomes. At best, our data can be construed as suggestive of a possible causal relationship that could be confirmed through longitudinal methodology. Such a design would permit exploration of how negative interactions interact with biological and emotional processes to impact – and be impacted by -- IBS symptoms. Our data reflected a subset of treatment-seeking individuals who were willing to enroll in a behaviorally based randomized controlled trial. Therefore, our findings may not necessarily generalize to less psychologically oriented IBS patients or those from primary care settings or community populations (i.e., nonconsulters) representative of the majority of individuals with symptoms compatible with IBS. While our measures satisfy accepted standards for psychometric soundness, data is based on self-report which mean they are subject to some bias and measurement error. We do not believe that our reliance on self-report invalidates our findings. In the case of our comorbidity assessment, previous research indicates that self-report of diagnoses using chronic condition checklist like the one we used generally show good agreement with physical records data [75-77] and is actually regarded as a more accurate estimate of comorbidity than existing measures that use different methodologies[78]. To reduce paperwork burden, we used a brief measure of negative interactions even though we recognize that negative encounters, like social support, are a complex, multidimensional construct that encompasses different kinds of exchanges [79] such as unwanted advice, others failure to provide help when needed, unsympathetic behavior and rejection/neglect. Future research that assesses different dimensions or types of negative social interaction will improve upon this aspect of our study. While we focused on perceived support, we recognize that social support takes many other forms (enacted support, social integration) which are only weakly correlated with one another[80].

In spite of these imperfections, we believe these data adds precision to the biopsychosocial model of IBS by highlighting the important role that quality of social relationships likely

plays in the expression of IBS and related problems. We hope these data will stimulate further research and the development of patient-focused treatment options.

Acknowledgments

Grant support: This study was funded by NIH Grant DK77738.

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Table 1

Demographics

	M (SD)	N (%)
Age	41.0 (15.0)	
Gender (%Female)		184 (78.3%)
Race (% White)		209 (88.9%)
Education		
High School or less		47 (20.0%)
College Degree		101 (43.0%)
Post-college degree		68 (28.9%)
Other		19 (8.1%)
Income		
< 15,000		21 (8.9%)
15,001 – 30,000		26 (11.1%)
30,001 – 50,000		45 (19.1%)
50,000 – 75,000		39 (16.6%)
75,001 – 100,000		18 (7.7%)
100,001 – 150,000		27(11.5%)
>150,000		23 (9.8%)
No answer/Don't know		36 (15.3%)
Duration of sxs (years)	16.2 (14.0)	
IBS Subtype		
IBS-Constipation		69 (29.4%)
IBS-Diarrhea		97 (41.3%)
IBS-Mixed		69 (29.4%)
IBS-SSS	285.2 (76.9)	
IBS-QOL	56.5 (18.9)	
Abdominal Pain	5.0 (2.0)	
# Medical Comorbidity	7.8 (6.2)	
NIS	10.1 (3.2)	
BSI-Depression	4.5 (4.5)	
SOMS-7	12.0 (6.5)	
STAI-Trait Anxiety	20.5 (6.3)	
ISEL	39.5 (6.6)	
PSS	6.8 (3.3)	

Note. IBS-SSS- Irritable Bowel Syndrome Symptom Severity Scale, IBS-QOL-Irritable Bowel Syndrome Quality of Life, # Medical Comorbidities-Number of Medical Comorbidities, BSI-Depression-Brief Symptom inventory Depression Scale, SOMS-7- Screening for Somatoform Symptoms, STAI-Trait-State Trait Anxiety Inventory-Trait Scale, ISEL- Interpersonal Support Evaluation List, PSS- Perceived Stress Scale.

Table 2a

Mean Differences Among Negative Interaction (NI) Quartile Groups

	Negative Interaction Group			
	1st Quartile (n = 50)	2nd Quartile (n = 65)	3rd Quartile (n = 66)	4th Quartile (n = 51)
IBS-SSS	276.50 (95.6)[1]	271.88 (67.5)[1]	288.12 (68.3)[1,2]	306.77 (75.4)[2]
IBS-QOL	59.44 (18.8)[1]	61.58 (16.2)[1]	56.68 (18.0)[1]	46.96 (20.4)[2]
PSS	5.16 (2.8)[1]	5.82 (2.7)[1]	7.29 (2.9)[2]	9.45 (3.3)[3]
Ab Pain	4.58 (2.2)[1]	4.59 (2.0)[1]	5.28 (1.7)[1,2]	5.46 (2.1)[2]
BSI-Depression	3.04 (4.1)[1,2]	2.86 (3.1)[1]	4.47 (3.8)[1,2]	8.16 (5.3)[3]
Somatization	11.10 (5.6)[1,2]	10.21 (5.2)[1]	12.44 (6.9)[1,2]	14.84 (7.3)[3]
Trait Anxiety	18.37 (6.1)[1]	18.39 (4.8)[1]	20.29 (4.7)[1]	25.78 (6.8)[2]
Med Comorb	5.71 (4.9)[1]	6.97 (5.3)[1,2]	8.82 (6.8)[2,3]	9.62 (7.0)[3]
Social Support	41.24 (5.5)[1]	40.32 (5.7)[1]	39.86 (5.7)[1]	36.29 (6.6)[2]

Note. Within rows, means with similar superscripts are statistically similar to one another and means with different superscripts are statistically different from one another at $p < .05$. IBS-SSS- Irritable Bowel Syndrome Symptom Severity Scale, IBS-QOL-Irritable Bowel Syndrome Quality of Life, PSS- Perceived Stress Scale, BSI-Depression-Brief Symptom inventory Depression Scale, SOMS-7- Screening for Somatoform Symptoms, STAI-Trait-State Trait Anxiety Inventory-Trait Scale, Comorbid-Medical Comorbidites.

Table 2b

Mean Differences Among Social Support Quartile Groups

	Social Support Group			
	1st Quartile (n = 50)	2nd Quartile (n = 65)	3rd Quartile (n = 66)	4th Quartile (n = 51)
IBS-SSS	293.16 (75.2)[1]	273.60 (81.3)[1]	285.09 (64.8)[1]	284.14 (82.0)[1]
IBS-QOL	52.25 (18.9)[1]	53.21 (17.1)[1]	56.00 (19.2)[1]	63.61 (18.2)[2]
PSS	8.21 (3.7)[1]	7.80 (3.0)[1]	6.08 (2.8)[2]	5.63 (2.9)[2]
Ab Pain	5.19 (1.8)[1]	4.80 (2.4)[1]	4.51 (2.1)[1]	5.22 (1.8)[1]
BSI-Depression	6.40 (5.1)[1]	6.29 (4.9)[1]	3.14 (3.1)[2]	2.53 (3.4)[2]
Somatization	12.36 (7.0)[1]	15.04 (6.4)[2]	10.65 (5.6)[1]	10.21 (5.7)[1]
Trait Anxiety	22.84 (6.5)[1]	22.38 (5.9)[1]	19.76 (5.7)[2]	17.79 (5.4)[2]
Med Comorb	9.16 (6.8)[1]	9.53 (6.3)[1]	5.80 (4.6)[2]	6.72 (6.2)[2]

Note. Within rows, means with similar superscripts are statistically similar to one another and means with different superscripts are statistically different from one another at $p < .05$. IBS-SSS- Irritable Bowel Syndrome Symptom Severity Scale ,IBS-QOL-Irritable Bowel Syndrome Quality of Life, PSS- Perceived Stress Scale, Ab Pain-Abdominal Pain, BSI-Depression-Brief Symptom inventory Depression Scale, SOMS-7- Screening for Somatoform Symptoms, Trait Anxiety-State Trait Anxiety Inventory-Trait Scale, Med Comorbid-Medical Comorbidites.

Table 3

Partial Correlations Between Negative Interactions, Social Support, and Independent Variables (Controlling for Confounding Variables)

	1	2	3	4	5	6	7	8	9	10
1.NIS	-									
2.ISEL	**−.26**	-								
3.IBS-SSS	**.17**	−.08	-							
4.IBS-QOL	**−.29**	**.27**	**−.46**	-						
5. Abdominal Pain	**.20**	−.03	**.48**	**−.21**	-					
6.PSS	**.53**	**−.36**	**.18**	**−.46**	.12	-				
7.BSI-Dep	**.45**	**−.39**	**.22**	**−.45**	.08	**.64**	-			
8.STAI-Trait	**.47**	**−.37**	**.15**	**−.46**	.03	**.67**	**.72**	-		
9.SOMS-7	**.27**	**−.17**	**.26**	**−.37**	.12	**.33**	**.33**	**.29**	-	
10.Med Comorbid	**.26**	**−.19**	.07	**−.14**	.05	**.28**	**.19**	**.19**	**.46**	-

Note. NIS-Negative Interactions Scale, ISEL-Interpersonal Support Evaluation List, IBS-SSS- Irritable Bowel Syndrome Symptom Severity Scale, IBS-QOL-Irritable Bowel Syndrome Quality of Life, PSS-Perceived Stress Scale, BSI-Depression-Brief Symptom inventory Depression Scale, STAI-Trait-State Trait Anxiety Inventory-Trait Scale, SOMS-7- Screening for Somatoform Symptoms, Med Comorbid-Medical Comorbidites.

Table 4

Hierarchical Regressions with IBS – Quality of Life as Dependent Variable

	Estimate	SE	β	R^2	ΔR^2
Step 1				.105	**.105**
Age	.24	.10	**−.19**		
Gender	−1.59	2.91	−.04		
Race	−.26	3.51	−.01		
Education	2.75	.63	**.28**		
Income	2.01	1.43	−.09		
Duration Sx	−.16	.10	−.12		
Step 2				.289	**.184**
Age	.15	.09	.12		
Gender	−.64	2.61	.02		
Race	1.03	3.09	−.03		
Education	1.10	.59	.11		
Income	1.17	1.25	−.05		
Duration Sx	−.06	.09	−.04		
Abd Pain	−1.11	.55	−.12		
Med Comor	.17	.21	.06		
BSI-Depression	−.47	.35	−.11		
Somatization	−.62	.19	**−.21**		
Trait Anxiety	−.57	.26	**−.19**		
Perceived Stress	−.94	.47	**−.17**		
Step 3				.413	**.124**
Age	.16	.09	−.13		
Gender	−1.05	2.45	−.02		
Race	.90	3.09	.02		
Education	1.07	.60	.11		
Income	1.04	1.26	.05		
Duration Sx	−.05	.09	−.04		
Abd Pain	−1.15	.56	−.12		
Med Comor	.17	.21	.06		

	Estimate	SE	β	R^2	ΔR^2
BSI-Depression	−.42	.36	−.10		
Somatization	−.62	.19	**−.21**		
Trait Anxiety	−.56	.27	**−.18**		
Perceived Stress	−.92	.49	**−.17**		
Social Support	.61	.23	**.18**		
Neg Interactions	−.97	.41	**−.19**		

Note. Numbers that are **bolded** are significant at $p < .05$. Duration Sx- Duration of Symptoms, Abd Pain-Abdominal Pain, Med Comor-Medical Comorbidities, BSI-Depression-Brief Symptom inventory Depression Scale, SOMS-7- Screening for Somatoform Symptoms, STAI-Trait-State Trait Anxiety Inventory-Trait Scale, PSS- Perceived Stress Scale, Neg Interactions-Negative Interactions Scale.