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Irritable bowel syndrome and symptom severity: Evidence of negative attention bias, diminished vigour, and autonomic dysregulation

Kristy Phillips, Bradley J. Wright, Stephen Kent *

School of Psychological Science, La Trobe University, Melbourne, Australia

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ABSTRACT

Objective: To determine if cognitive processing, and subjective and physiological responses to stress and relaxation differed between an irritable bowel syndrome (IBS) group and control group. How these variables relate to the severity of IBS symptoms was also determined.
Methods: Twenty-one IBS participants and 20 controls provided cognitive (attention and processing), subjective (perceived stress and vigour), and physiological (heart rate, blood pressure, and skin conductance) data during a relaxation and stress phase. Logistic regression analyses determined which variables are related to the IBS group and hierarchical linear regression assessed how the variables are related to the severity of IBS symptoms.
Results: Subjective and cognitive factors (drowsiness at baseline, total vigour, and reduced Stroop colour-naming accuracy for negative words) are significantly related to IBS, χ^2 (3, N = 41) = 23.67, p < .001, accurately categorising 85% of participants. IBS symptom severity was associated with both subjective (drowsiness at baseline and a smaller reduction in tiredness from relaxation to stress) and physiological (smaller increase in systolic blood pressure from baseline to stress phase and lower skin conductance at baseline) variables. This model predicted IBS severity, F (4, 16) = 11.20, p < .001, and accounted for 74% of the variability in scores.
Conclusions: A negative attention bias, which may be related to a negative self-schema, as well as perceived low vigour were important in categorising IBS. Low subjective vigour and reduced physiological reactivity to both relaxation and stress conditions were associated with IBS severity, suggestive of illness-related allostatic load.

Introduction

Irritable bowel syndrome (IBS) is a chronic functional gastrointestinal disorder, characteristically presenting with varied intestinal problems including abdominal pain, diarrhoea, constipation, bloating, gas, and urgency [1]. Presently, the most comprehensive diagnostic tool for IBS is the Rome III criteria, which specifies that an individual experiences abdominal pain or discomfort for at least 3 days per month for a 3 month period, along with changes in stool frequency, or form, or the discomfort is relieved with defecation [2]. No identifiable structural abnormality, biological marker, or specific bacterial imbalance have been identified to explain these symptoms [3]. Around 10% of the general population and up to 25% in Western countries meet diagnostic criteria for IBS [4,5]. Along with individual and social impacts, IBS also presents a huge financial burden to the health care system [6].

This complex and multi-factorial disorder is best conceptualised by the biopsychosocial model. Accordingly, IBS symptoms manifest from the combined effect of individual biology (genetic and gastrointestinal physiology), psychological predispositions (behaviours, higher order cognitions, psychological distress, personality, and coping styles), and one's social environment (early life experiences, trauma, stress, modelling, and reinforcement) [7,8].

Healthy food digestion and bowel movements require bi-directional communication between the enteric nervous system, the central nervous system (CNS), and the hypothalamic–pituitary–adrenal (HPA) axis [9–11]. Communication in the 'brain–gut axis' takes place through neural, hormonal, and immunological pathways [12,13].

Disrupted communication between the ANS and the CNS exists in some cases of IBS; evident in attention-biases (i.e., towards gastrointestinal and negative cues) [27–29] and a heightened awareness of somatic and visceral symptoms [14,30]. To our knowledge no study has explored how these biases impact on engagement in bodily-focused relaxation. Progressive muscle relaxation (PMR), a technique that encourages inward awareness of bodily states to consciously release tension, has been used in various populations for relaxation, but its effects on IBS are largely unknown.

Abbreviations: ANS, autonomic nervous system; CNS, central nervous system; DBP, diastolic blood pressure; HPA, hypothalamic–pituitary–adrenal; HR, heart rate; IBS, irritable bowel syndrome; IBS-SSS, irritable bowel syndrome symptom severity score; PMR, progressive muscle relaxation; PNS, parasympathetic nervous system; SBP, systolic blood pressure; SCR, skin conductance response; SNS, sympathetic nervous system; VAS, visual analogue scale.

* Corresponding author at: School of Psychological Science, La Trobe University, Bundoora, VIC 3086, Australia. Tel.: +61 3 9479 2798; fax: +61 3 9479 1956.
E-mail address: s.kent@latrobe.edu.au (S. Kent).

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A number of pathophysiological factors impact on the functioning of the 'brain–gut axis' [10–14]. Some of the most interesting and perplexing findings relate to the impacts of stress, on subjective, cognitive, and physiological mechanisms in IBS. Stress has been implicated in both illness cause, and also in symptom exacerbation [15,16].

IBS has generally been associated with increased sympathetic nervous system (SNS) activity and decreased parasympathetic nervous system (PNS) activity [17–20], yet, the inverse [21,22], and also no autonomic irregularities have been reported [23,24]. Skin conductance response (SCR) has a long history of use as an indicator of SNS activity [23,25]. To date SCR has provided varied results regarding SNS activity in IBS [13,22,24] possibly reflecting that IBS is a heterogeneous disorder [26].

Reactions to stress conditions have been found to differ between IBS and control groups in perception of arousal, mood, stress, and confusion [31,32], and this exists irrespective of physiological differences. Evidently in IBS, sensory, memory, and somatic inputs are received cognitively and affectively distorted [33,34], which may influence somatic and visceral symptoms [35], along with stress responses [31,32].

With increased exposure to stress the human body adapts and changes to achieve stability and maintain homeostasis; a process known as allostasis [36,37]. Allostasis emphasises that healthy functioning requires ongoing adjustments of internal physiological systems adapting to environmental demands. However, repeated stress can be detrimental to the body and the brain. Allostatic 'load' can manifest physically as predispositions to certain diseases, and psychologically as fatigue, anger, frustration, anxiety, and worry [37]. Research has suggested that allostasis may be implicated in IBS [38,39]; however, allostatic load has not been quantified within IBS.

In the present study we sought to compare control and IBS participants before, during and after an acute psychological stressor to determine: (i) if there were subjective, cognitive, and physiological differences between groups and if these factors are related to symptom severity, (ii) what subjective, cognitive, and physiological factors were the most important in distinguishing IBS participants from controls, (iii) if stress and relaxation phases elicit similar responses from both groups, and (v),if the data suggest that IBS is related to allostatic load.

Method

Participants

Participants presented as two discrete groups: a self-reported diagnosed IBS group ($n = 21$) and a control group ($n = 20$). An a priori power analysis was conducted using G*Power version 3.0.12 software and based on findings of comparable studies [22,25,27,28,32] an effect size of .35 was used with power set at .80 and alpha at .05 to determine that N = 16 in each group was required to conduct the largest MANOVA analyses which included 4 dependent variables.

The groups did not differ significantly in age, gender, relationship status, or education (Table 1). IBS participants held a diagnosis on average for 5.5 years ($SD = 5.65$). IBS participants reported their predominant symptom to be diarrhoea ($n = 4$), constipation ($n = 4$), alternating between diarrhoea and constipation ($n = 10$), or bloating/pain ($n = 3$). In both groups participants were excluded if they had a current or past diagnosis of an organic bowel disease (e.g., ulcerative colitis, Crohn's disease), a past or present eating disorder, pregnancy, and current use of opioid, glucocorticoid, steroid, psychotropic, or anti-depressant pharmaceuticals. Inclusion criteria stipulated that participants were Australian residents aged 18 years and over. All IBS participants were required to have been diagnosed prior to participation by a doctor or gastroenterologist. Participants were recruited via print advertisements distributed to IBS support services, local gastroenterologists, and around the university campus. An online advertisement was also placed with

Table 1
Participant characteristics

	Control (n = 20)	IBS (n = 21)	*P*
Gender, males/females (%)	30/70	14/86	.24[a]
Age, year *M* (SD)	30.2 (9.5)	33.8 (12.8)	.31[b]
Relationship (%)			.29[a]
In a relationship	55	71	
Single	45	29	
Smoker Y/N (%)	0/100	0/100	1.00[a]
Highest level of education (%)			.25[a]
Pre-university Educated	25	33	
University educated	75	67	
IBS diagnosis duration, year *M* (SD)		5.52 (5.65)	
Predominant IBS symptom (%)			
Constipation/diarrhoea/alternating/pain and bloating		19/19/48/14	
IBS severity score *M* (SD)		230.9 (73.7)	

[a] Group differences calculated using non-parametric Chi-square analyses.
[b] Group differences calculated using one-way ANOVA.

The Gut Foundation. Institutional ethics approval was granted from La Trobe University Human Ethics Committee (HEC10/R67).

Study measures

Demographic details collected were age, gender, relationship status, education, and smoking status. The Irritable Bowel Syndrome Symptom Severity Score IBS-SSS [40], a 5-question self-report questionnaire assessed symptoms over the past 10-days. Severity classifications are: mild (75–<175), moderate (175–<300), and severe (>300).

Subjective and cognitive factors

Subjective vigour and subjective stress states were measured using 4 visual analogue scales (VAS) ranging from −5 to +5 (0 = a neutral response). The vigour scales were anchored: VAS-V1 (tired–energetic), and VAS-V2 (active–drowsy). The stress scales were anchored: VAS-S1 (tense–peaceful), and VAS-S2 (relaxed–worried) [32]. All scales were administered at 3 time points (arrival, post-relaxation phase, and post-stress phase), and reliability in the current study was good (Cronbach's $\alpha = .81$).

Attention and processing were assessed with a modified emotional Stroop test [27,41,42] comprised of neutral words paired with stimulus word categories: positive, negative, and gastrointestinal (Table 3). Two practice trials were followed by 9 blocks, each consisting of 15 experimental trials. Each block presented a set of stimulus and neutral words with both the words and blocks presented in random order. Words were capitalised 1 cm in height displayed on a 14 inch laptop monitor for 50 ms. Participants responded to the randomised colour of the word (either 'b' indicating blue or 'g' indicating green) with a maximum response time of 800 ms. Response accuracy and reaction times were recorded.

Physiological factors

SBP and DBP were measured using an automatic blood pressure monitor (Omron Model SEM-2) at three time points: beginning of baseline, and immediately following relaxation, and stress phases. A finger-pulse monitor worn by participants was attached to a GSR076 amplifier that converted to HR recorded on PowerLab Chart 5© v5.2.2 for Microsoft Windows (AD Instruments, 2005). Participants wore on the distal index and pointer phalanges of the left hand a pair of silver chloride electrodes that attached to the GSR076 amplifier recording SCR in microsiemens (uS) in PowerLab Chart 5© v5.2.2 for Microsoft Windows.

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