A randomized trial of yoga for adolescents with irritable bowel syndrome

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BACKGROUND: Adolescents with irritable bowel syndrome (IBS) frequently experience interference with everyday activities. Mind-body approaches such as yoga have been recommended as interventions for patients with IBS. Despite promising results among adult samples, there have been limited studies exploring the efficacy of yoga with pediatric patients.

OBJECTIVE: To conduct a preliminary randomized study of yoga as treatment for adolescents with IBS.

METHODS: Twenty-five adolescents aged 11 to 18 years with IBS were randomly assigned to either a yoga or wait list control group. Before the intervention, both groups completed questionnaires assessing gastrointestinal symptoms, pain, functional disability, coping, anxiety and depression. The yoga intervention consisted of a 1 h instructional session, demonstration and practice, followed by four weeks of daily home practice guided by a video. After four weeks, adolescents repeated the baseline questionnaires. The wait list control group then received the yoga intervention and four weeks later completed an additional set of questionnaires.

RESULTS: Adolescents in the yoga group reported lower levels of functional disability, less use of emotion-focused avoidance and lower anxiety following the intervention than adolescents in the control group. When the pre- and postintervention data for the two groups were combined, adolescents had significantly lower scores for gastrointestinal symptom, pain, functional disability, less use of emotion-focused avoidance and lower anxiety following the intervention than adolescents in the control group. Adolescents found the yoga to be helpful and indicated they would continue to use it to manage their IBS.

CONCLUSIONS: Yoga holds promise as an intervention for adolescents with IBS.

Keywords: Adolescents; Irritable bowel syndrome (IBS); Mind-body; Recurrent abdominal pain; Yoga

Despite high rates of prevalence and the disabling nature of the condition, IBS is not well understood. Only recently have criteria for diagnosis of IBS in adults been adopted through a consensus forum (5). Although IBS has been the focus of many investigational studies, little definitive information is available concerning etiology and treatment. However, it is generally well accepted that stress and anxiety can exacerbate IBS symptoms (6). Recent research indicates that IBS may be a result of alteration in the perception of visceral events and altered regulation of gastrointestinal motility and epithelial function (7,8). The data from functional magnetic resonance
imaging studies (9) suggest that IBS patients differ from healthy controls in that those with IBS show an activation of pain amplification regions with no activation of inhibitory pain areas, leading to visceral hypersensitivity. Mayer (9) suggests a disruption model for intervention with this brain-gut axis in which pain persistence is disrupted by either pharmacology or mind-body therapies, such as hypnosis. While the exact mechanisms leading to the clinical entity of IBS is not fully known, it is clear that both physiological and emotional factors are integrated in a complex way to modulate the symptoms in any given individual.

Many different interventions have been recommended to manage IBS, including nutrition, exercise, medication, behaviour modification and emotional support (1). Little research, however, has systematically examined these interventions among pediatric patients. As a result, no reliable evidence-based treatment intervention exists to help children and adolescents with IBS alter their maladaptive patterns, reduce pain and distress, and increase participation in daily living activities.

Recently, mind-body approaches such as hypnosis have been recommended as holding considerable promise as meaningful and cost-effective interventions for adult patients with IBS (10). Mind-body approaches also include tai-chi, meditation and yoga, among others. Yoga is one of the most commonly practiced mind-body practices, with an estimated 15 million American adults having used yoga in the past year (11). Nearly 50% of adults who have used yoga report that they have used it to manage a health condition (11). Of the various forms or systems of yoga that have evolved over the centuries, the more active form of yoga, Hatha yoga, involves physical poses and controlled breathing. One of the most common forms of Hatha yoga practiced in North America is Iyengar. The main component of the practice of Iyengar is the poses, or, in Sanskrit, ‘asanas’. In essence, a person will assume a number of stationary poses that use contraction and relaxation of different muscles to create specific body alignments (12). The physical postures with breathing and meditative techniques involved in yoga are intended to reduce anxiety, improve body tone and increase feelings of well-being (13).

An increasing number of studies have examined the effectiveness of yoga among adults for managing painful conditions, such as migraine (14,15), carpal tunnel syndrome (16), osteoarthritis (17) and multiple sclerosis (12), as well as other health conditions, such as asthma (18), hypertension (19) and chronic low back pain (20). After 16 weeks of Iyengar yoga, Williams et al (20) found a significant decrease in pain and functional disability associated with chronic back pain. Among adult patients with IBS, yoga was recently found to decrease bowel symptoms and anxiety, and enhance parasympathetic reactivity (21).

Of the limited research involving pediatric samples, yoga has been used to improve posture among children with physical malformations (22) and to treat anxiety in child and adolescent psychiatric patients (23). Yoga has been found to improve children’s hyperactive and inattentive behaviour, self-esteem and relationship quality with parents (24). Additionally, Telles and Srinivas (25) found yoga to decrease physiological anxiety among children with vision impairments. Similarly, Jain et al (26) found that yoga exercises in adolescents who had childhood asthma resulted in an increase in pulmonary function and exercise capacity. A published abstract by Raghavan et al (27) reported the results of a four-month yoga protocol among a small group of young adults (aged 15 to 22 years) with IBS. They found decreased illness perception and increased general well-being, but no direct improvements in IBS symptoms. However, the results of this preliminary study were based on the randomization of a total of only seven IBS patients to either a yoga intervention or wait list control group, and no statistical analyses were reported. Anecdotal reports of the use of yoga with children with IBS in our clinical practice suggest the potential for efficacious outcomes; however, controlled research is needed to systematically examine yoga as a potential treatment for IBS.

The purpose of the present study was to determine whether an instructional session in yoga followed by four weeks of daily yoga practice using a video of selected yoga poses (asanas) for abdominal comfort would result in a reduction in pain, gastrointestinal symptoms and functional disability (primary outcomes) among adolescents with IBS when compared with a wait list control group. In addition, the effects of yoga on coping, anxiety and depression were also explored (secondary outcomes). It was expected that adolescents who received the yoga treatment would report lower scores in each of these domains following the yoga interventions when compared with those in the control group.

METHODS

Participants
Adolescents were recruited from either the gastroenterology clinic at the local children’s hospital (n=9) or through the community via posters (n=19). Participants had to self-identify as having abdominal pain and meet criteria for IBS via telephone screening to be eligible to participate in the study. The university and hospital ethical review committees approved the study.

Twenty-eight adolescents (eight boys and 20 girls) between the ages of 11 and 18 years (mean age 14.15±1.95 years) who met the Rome I criteria for IBS (28) were enrolled in the study and were randomly assigned to either the yoga intervention group (n=14; 12 girls and two boys) or the wait list control group (n=14; eight girls and six boys). The Rome I criteria for IBS were applied given concerns that the Rome II criteria are unnecessarily restrictive for research and practice (29). The average age of those in the yoga group and control group was 14.36±2.10 and 13.83±1.89 years, respectively. Of those in the yoga group, 13 self-identified as Caucasian and one as First Nations. Three boys dropped out of the control group and were excluded from analyses, resulting in a final sample size of n=11 for the control group, which included nine Caucasians, one Asian and one Indo-Canadian. This sample size was calculated to be sufficient to detect large effects sizes for between-groups analyses and moderate-to-small effects sizes for the within-subjects analyses (30).

Measures

Pain intensity: Adolescents provided a rating of their general level of pain intensity over the past month using a 0 to 10 numeric rating scale.

Gastrointestinal symptoms: Adolescents rated their level of IBS symptoms (eg, diarrhea and bloating) over the last month using a checklist developed by Blanchard and Scharff (31). Total symptom scores ranged from 0 to 3.

Functional Disability Inventory (32): The Functional Disability Inventory is a 15-item questionnaire for school-age children and adolescents that assesses levels of pain- and illness-related...
interference with activities of daily living. Items are rated on a five-point scale (0 = ‘none’ and 4 = ‘impossible’). A total score (ranging from 0 to 60) is obtained by summing item responses.

**Pain Coping Questionnaire (33):** The Pain Coping Questionnaire is a 39-item questionnaire validated for use with children and adolescents in assessing pain coping strategies. Items are rated on a five-point scale (0 = ‘never’ to 4 = ‘very often’). Factor analyses support an underlying structure of three scales: Approach Coping (eg, information seeking and problem-solving), Distraction (eg, behavioural distraction and cognitive distraction) and Emotion-Focused Avoidance (eg, externalizing, internalizing). Scores for each of the three scales (ranging from 0 to 4) were obtained by averaging responses to appropriate items.

**Revised Child Manifest Anxiety Scale (34):** The Revised Child Manifest Anxiety Scale is a 37-item measure of anxiety symptoms in children and adolescents. Items are rated as present or absent. A total anxiety score (ranging from 0 to 31) is calculated by summing the number of anxiety items endorsed as present (items from an additional six items assessing response style are not included in the total anxiety score).

**Children’s Depression Inventory – Short Form (35):** The Children’s Depression Inventory – Short Form is a 10-item questionnaire. For each item, children select from among three statements the one that best describes how they have been feeling in the last two weeks. Scores are assigned from 0 to 2. A total score (ranging from 0 to 20) is obtained by summing item responses.

**Procedure**
A structured telephone screening by a trained research assistant was conducted with each adolescent and one of their parents to confirm eligibility for the study (ie, age 11 to 18 years, meeting diagnostic criteria for IBS, English-speaking, with a television and video cassette player at home). Subsequently, adolescents were randomly assigned to either the yoga intervention or wait list control group using a sequence of randomly determined numbers. On the day of the intervention, informed written consent was obtained from parents and written and verbal assent was obtained from adolescents. Adolescents in both groups provided basic demographic information (ie, age, sex and ethnicity) and completed a series of questionnaires consisting of the measures described above.

After completing the questionnaires, the yoga group participated in a 1 h instructional session that included verbal instruction, videotaped and live demonstration, and assisted practice with a yoga teacher (certified in Hatha and Iyengar). The yoga intervention consisted of a brief introduction to yoga as well as watching and participating in the yoga video program. In the video, a yoga teacher and two adolescents demonstrated a series of poses that required a total of 10 min to complete. All participants were given the same poses and breathing instructions (Table 1), selected for the purported easing and self regulation on the abdomen and bowel. The series began with lying prone using poses known as the cat, the child, the bridge, sitting twists and standing forward bend, all accompanied by regulated deep relaxed breathing, while attuning to abdominal sensory changes and releasing tension. If pain was experienced the participants were instructed “to notice how your belly feels during the pose”. The instructor often gave the adolescents cues to focus on where they currently felt or tended to feel pain. Examples included: “Take a deep breath in and as you exhale, begin to let the pain out” and “rub your hands together making them warm and put them on your body where you feel pain or tightness.” (Copies of the yoga video are available to patients and professionals from the first author at a cost of $25 per video to cover dubbing and postal charges.) This yoga video, designed by the authors for adolescents with IBS, was provided to each adolescent to take home for daily practice over four weeks. Adolescents in the wait list group were asked to manage their IBS as they typically would during this four-week period. Adolescents in both groups completed the same questionnaires at baseline at the end of the four-week period. The wait list group subsequently received the yoga intervention and completed a final set of questionnaires following their four weeks of home practice.

Adolescents were asked to rate, using a series of 0 to 10 scales, how frequently they practiced the yoga (0 = ‘never’ to 10 = ‘every day’), how helpful they found the yoga (0 = ‘not at all’ to 10 = ‘extremely’), how much they enjoyed doing the yoga (0 = ‘really didn’t like it’ to 10 = ‘really liked it’), and how easy the yoga was to do (0 = ‘very hard’ to 10 = ‘very easy’). Adolescents were asked to indicate (by answering ‘yes’ or ‘no’) whether they planned to continue using yoga to manage their IBS. Adolescents were also asked open-ended questions regarding perceived areas of improvement and barriers to regular yoga practice.

It is noted that, due to the small sample size and to maximize data, missing values were replaced with mean values (36) for the group, if the participant was missing item responses that precluded calculation of questionnaire scores. A total number of 21 missing data points across participants were substituted. Data were excluded when the number of missing items on a questionnaire exceeded 20%. As a result, data were not available for two participants for depression and one participant for anxiety at baseline, and one participant in the wait list group for depression at the second follow-up (postintervention).

**RESULTS**
A series of independent sample t tests for the continuous measures (eg, child’s age) and a series of x² analyses for the categorical measures (eg, child’s ethnicity) were conducted to examine group differences in demographic characteristics of the two groups. There were no significant group differences (P>0.10) for any of the variables, indicating that the random assignment was successful in ensuring equivalency in the demographic characteristics of the two groups. However, when t tests were conducted to examine equivalency in the responses to the various baseline questionnaires, a significant difference in pain intensity between the two groups was found (Table 2), with the wait list group reporting on average higher levels of pain intensity in the preceding month than the yoga group. There were no other significant group differences in the baseline measures. As a result of the significant difference in pain intensity at baseline, the possibility of including pain intensity as a covariate in subsequent analyses was explored. Because no differences in the outcome of the analysis emerged, whether pain intensity was used as a covariate or not, the results of the analysis without the covariate are presented below, for simplicity. However, given the difference at baseline, pain intensity was omitted as an outcome variable in the comparison of the two groups following the intervention.

The means and standard deviations for the adolescents’ scores on the various follow-up questionnaires after the yoga group had received the intervention also appear in Table 2. A multivariate ANOVA was used to examine group differences...
Although the convention for statistical significance is a cut-off of $P<0.05$, given the exploratory and preliminary nature of the present study, differences significant at $P<0.10$ or less were considered to be reflective of statistical trends worthy of interpretation as is commonplace for preliminary or pilot studies. For example, Garfinkel at al (16) conducted a pilot study examining the efficacy of yoga as a treatment for carpal tunnel syndrome; they set the significance level at $P<0.10$ and interpreted their results as meaningful statistical trends worthy of further study.

As shown in Table 2, adolescents who received the yoga intervention tended to report lower levels of functional disability ($F[1,23]=3.52, P=0.073$), lower levels of emotion-focused avoidance ($F[1,23]=3.13, P=0.09$) and lower levels of anxiety ($F[1,23]=3.13, P=0.09$) than adolescents in the control group. There were no group differences in adolescents’ use of approach coping ($F[1,23]=0.026, P=0.87$), distraction strategies ($F[1,23]=1.58, P=0.22$), depression ($F[1,23]=1.26, P=0.27$) or overall gastrointestinal symptoms over the four-week period ($F[1,23]=1.90, P=0.18$).
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After the wait list control group participated in the yoga intervention, their data were merged with that of the yoga group to allow for a global examination of pre- and postintervention effects using a series of paired samples t tests for the entire sample. Table 3 provides a summary of the means, standard deviations and results of the t tests. As the table illustrates, there was a significant reduction in reports of gastrointestinal symptoms (t(1,24)=3.15, P<0.01) and a trend for lower levels of emotion-focused coping (t(1,24)=2.82, P=0.10) following participation in the yoga intervention.

Following completion of the yoga intervention, adolescents indicated that they had practiced the yoga on a fairly frequent basis (mean 6.8±2.52 of 10), although many of the adolescents (n=16) reported difficulties completing the yoga on a daily basis due to other commitments (eg, school work, chores). Several of the adolescents (n=7) reported that it was difficult for them to practice the yoga when they were not feeling well. “When I was in pain the program was harder to do, but nothing would have made the actual program easier.”

Regardless, the adolescents indicated that the yoga was generally quite helpful (mean 7.18±2.46 of 10); they spontaneously reported that the yoga increased feelings of relaxation and calm (n=12), decreased pain (n=13), improved sleep (n=3) and increased energy or concentration (n=4). In addition, the adolescents reported that the yoga was very enjoyable (mean 8.24±2.07 of 10) and easy to do (mean 9.16±1.32 of 10). All but one of the adolescents (n=24) reported that they planned to continue to use the yoga to manage their IBS in the future.

Results are presented as mean ± SD. *Significant mean difference between groups at baseline, P<0.10; †Significant mean difference between the yoga and wait list control groups at follow-up, P<0.10. Note: Data for pain intensity at follow-up are not presented or analyzed because there was a significant difference between these groups at baseline. Revised Child Manifest Anxiety Scale (RCMAS) data were missing for one participant in the wait list condition at baseline. Revised Child Manifest Anxiety Scale (RCMAS) data were missing for two participants in the yoga condition at baseline. Children’s Depression Inventory (CDI) data were missing which have n=22 due to missing values. FDI Functional Disability Inventory; GI Gastrointestinal; PCQ Pain Coping Questionnaire; RCMAS Revised Child Manifest Anxiety Scale

**TABLE 2**

| Outcome measures for yoga and wait list control groups at baseline and four-week follow-up |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| **Yoga group** (n=14) | **Wait list control group** (n=11) | **Preintervention** | **Postintervention** | **Paired samples**<sup>t(24)</sup> |
| **Baseline** | **Follow-up** | **Baseline** | **Follow-up** | **Mean ± SD** | **Mean ± SD** | **P** |
| **Primary outcomes** | | | | | | |
| GI symptoms | 1.34±0.41 | 1.11±0.73 | 1.64±0.77 | 1.52±0.74 | | |
| Pain intensity | 4.93±1.74* | – | 6.82±2.40* | – | | |
| FDI | 24.87±12.85 | 24.36±12.90<sup>t</sup> | 31.55±11.60 | 34.00±12.55<sup>t</sup> | | |
| **Secondary outcomes** | | | | | | |
| CDI | 3.25±2.18 | 2.64±1.95 | 4.36±4.15 | 4.27±5.00 | | |
| RCMAS | 10.90±5.32 | 10.64±5.20<sup>t</sup> | 14.62±7.19 | 14.75±6.42<sup>t</sup> | | |
| PCQ | | | | | | |
| Emotion-focused avoidance | 1.29±0.58 | 1.07±0.54<sup>t</sup> | 1.64±0.87 | 1.66±1.10<sup>t</sup> | | |
| Distraction | 2.14±1.66 | 2.18±1.94 | 1.66±0.98 | 1.69±0.98 | | |
| Approach | 1.87±0.58 | 1.92±0.73 | 1.63±0.70 | 1.87±0.80 | | |

*Significant at P<0.10. Note: The above data are based upon an n=25 with the exception of Children’s Depression Inventory (CDI) and pain intensity which have n=22 due to missing values. FDI Functional Disability Inventory; GI Gastrointestinal; PCQ Pain Coping Questionnaire; RCMAS Revised Child Manifest Anxiety Scale

**TABLE 3**

| **Results of paired sample t tests comparing pre- and postintervention data after combining the two groups into one sample** |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| **Primary outcomes** | | | |
| GI symptoms | 1.42±0.57 | 0.93±0.66 | 3.15, P=0.004* | |
| Pain intensity | 5.73±2.32 | 5.14±1.95 | 1.34, P=0.20 | |
| FDI | 28.89±13.29 | 27.32±12.54 | 0.86, P=0.40 | |
| **Secondary outcomes** | | | |
| CDI | 3.72±3.83 | 3.14±2.55 | 1.25, P=0.23 | |
| RCMAS | 12.60±6.03 | 11.95±6.08 | 1.28, P=0.21 | |
| PCQ | | | | |
| Emotion-focused avoidance | 1.46±0.85 | 1.22±0.76 | 2.82, P=0.10* | |
| Distraction | 1.94±0.86 | 1.97±0.94 | –0.35, P=0.73 | |
| Approach | 1.87±0.67 | 1.96±0.65 | 1.07, P=0.29 | |

**DISCUSSION**

Following the recent interest in mind-body approaches for assisting patients with IBS (10), the present paper reports the results of a preliminary randomized study of yoga as an intervention for adolescents with IBS. Adolescents in the yoga group tended to report lower levels of functional disability, fewer emotion-focused avoidance pain coping strategies (ie, internalizing and externalizing), and less overall anxiety than adolescents in the control group. Additionally, after the control group received the yoga intervention and their pre- and postintervention data were merged with those of the yoga group, adolescents across both groups reported significantly lower levels of gastrointestinal symptoms and tended to report lower levels of emotion-focused coping. The results of these parallel sets of analyses, using both between-subject and within-subject analytical approaches, provides converging evidence for the benefits of yoga among adolescents with IBS. These findings are consistent with those reported by Taneja et al (21) among adult patients with IBS and those reported by Raghavan et al (27) in a smaller sample of young adults, where positive effects of yoga were found on general well-being. Mind-body methods such as yoga, with its reliance on deep relaxed abdominal breathing and attention to comfort, may disrupt chronic patterns of functional disability, anxiety and maladaptive coping, which subsequently could reduce overall levels of gastrointestinal symptoms.

In addition to beneficial effects in various areas of functioning, as assessed using validated measures, the adolescents themselves reported the yoga intervention to be helpful, enjoyable and easy to do. “It gave me something new that I hadn’t tried.” “When I felt the pain coming on and did the yoga, the pain was less after the yoga.” “I haven’t missed nearly as much school. It makes me a lot happier too.” “Though the pain is still there, you have done a lot to help me deal with it hadn’t tried.” “When I was in pain the program was harder to do, but nothing would have made the actual program easier.”

Regardless, the adolescents indicated that the yoga was generally quite helpful (mean 7.18±2.46 of 10); they spontaneously reported that the yoga increased feelings of relaxation and calm (n=12), decreased pain (n=13), improved sleep (n=3) and increased energy or concentration (n=4). In addition, the adolescents reported that the yoga was very enjoyable (mean 8.24±2.07 of 10) and easy to do (mean 9.16±1.32 of 10). All but one of the adolescents (n=24) reported that they planned to continue to use the yoga to manage their IBS in the future.
included pain and feelings of relaxation or calm. Nearly all of the adolescents reported plans to continue using yoga as a strategy for managing their IBS. Despite this endorsement, a number of the adolescents reported barriers to completing the yoga practice on a daily basis, due to other commitments such as school work or chores, despite the relatively minimal time required (ie, approximately 10 min each day). Additional consideration may need to be given to how yoga interventions can be delivered in a way that is most feasible and enjoyable given adolescents’ busy schedules. It is possible that more structure and peer interaction (eg, group classes) or individualized programs (which were not possible due to the video format of this intervention) may enhance adolescent motivation for completing daily yoga practice. A number of the participants stated that the program could have been more helpful for them if they had more yoga poses to choose from and if the video was longer. The video could be improved by providing an interactive digital video disc (DVD) where adolescents could select postures based on how they were feeling and where their pain (if any) was centralized.

The current study builds on this earlier work by using a randomized approach with a larger sample size and extends the recent findings among adult patients with IBS to a sample of adolescents. Although the relatively small sample size and corresponding low statistical power in the present study is a limitation, the positive effects reported in this paper are promising. The current study provides promising data regarding the potentially beneficial effects of yoga among adolescents with IBS and highlights areas that should be assessed and issues that need to be considered in future research. For example, future randomized trials are needed with larger sample sizes to replicate and extend the results of the present study. It would also be important for future studies to extend the follow-up period beyond four weeks and explore alternate methods for delivering the yoga intervention. In the meanwhile, it appears that yoga is a mind-body approach found to be enjoyable by many adolescents with IBS; yoga shows promise as a valuable intervention for this population.

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