Medical Science

pISSN 2321–7359; eISSN 2321–7367

The prevalence of irritable bowel syndrome among medical students and interns at Tabuk University

Hyder Osman Mirghani[1], **Majed Mohammed Alshehri**[2*], **Jalawi Talal A Alotaibi**[2], **Faisal Shiraz M Alharthi**[2], **Abdulaziz Abdullah Albalawi**[2], **Mohammed Aali Alghamdi**[2], **Abdulrahman Jawdat Albalawi**[2], **Yazeed Hamdan O Alwabisi**[2], **Bander Mohammed Abu Murad**[2], **Waleed Farhan Alshammari**[2], **Mohammed Ibrahim Fareed Bin Ibrahim**[3]

To Cite:
Mirghani HO, Alshehri MM, Alotaibi JTA, Alharthi FSM, Albalawi AA, Alghamdi MA, Albalawi AJ, Alwabisi YHO, Murad BMA, Alshammari WF, Ibrahim MIFB. The prevalence of irritable bowel syndrome among medical students and interns at Tabuk University. Medical Science 2022; 26: ms497e2581.
doi: https://doi.org/10.54905/disssi/v26i129/ms497e2581

Authors' Affiliation:
[1]Professor of Medicine and Endocrine, Medicine Department, College of Medicine, Tabuk University, Tabuk, Saudi Arabia
[2]Medical intern, Tabuk University, Tabuk, Saudi Arabia
[3]Medical student, Tabuk University, Tabuk, Saudi Arabia

*Corresponding author
Medical intern, Tabuk University, King Faisal Road, Tabuk, Saudi Arabia
Email: majedmhmd@gmail.com

Peer-Review History
Received: 07 November 2022
Reviewed & Revised: 09/November/2022 to 21/November/2022
Accepted: 23 November 2022
Published: 27 November 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Objectives: This study was conducted among medical students and interns at Tabuk University, Saudi Arabia to estimate irritable bowel syndrome (IBS) prevalence and explores its risk factors. *Methods:* Using a questionnaire this cross-sectional study collected data regarding the participants' characteristics, red flag signs of colorectal cancer, Rome III criteria, HADS-A questionnaire and lifestyle habits. *Results:* Out of 215 participants, 22.8% had IBS. Univariate analysis showed significant association between IBS and female gender (p=0.007), family history of IBS (p<0.001) and celiac disease (p=0.002), sleep duration<6 hours/day (p<0.001) and anxiety disorder (p<0.001). Multivariate analysis showed significantly increased likelihood of IBS with family history of IBS (OR: 3.583, 95% CI: 1.518–8.460, p=0.004) and celiac disease (OR: 3.896, 95% CI: 1.124–13.507, p=0.032), sleeping<6 hours/day (OR: 11.288, 95% CI: 2.956–43.106, p<0.001) and having higher HADS-A score (for each increase by one point: OR: 1.194, 95% CI: 1.068–1.336, p=0.002). *Conclusions:* Prevalence of IBS was 22.8% and the detected independent preventable risk factors were sleeping<6 hours/day and having an anxiety disorder. Future studies should assess IBS impact on academic achievements and clinical performance of students and healthcare workers.

Keywords: Irritable bowel syndrome, medical student, prevalence, risk factors

1. INTRODUCTION

Irritable bowel syndrome (IBS) is considered among the most common disorders of the gastrointestinal tract. The disease is chronic and is characterized by changes in bowel habits, abdominal discomfort or pain and

abdominal distension without organic etiology (Schoenfeld, 2016).

The prevalence of IBS widely varies from one country to another and sometimes within the same country from one region to another (Lovell and Ford, 2012). Based on a study that included data from 33 countries the prevalence of IBS ranges mostly from 3% to 5% in the general population (Palsson et al., 2020). However, higher prevalence rates (5-10%) were reported from the United States, Europe, New Zealand and Australia (Lovell and Ford, 2012; Sperber et al., 2017).

The etiological mechanism of IBS is not precisely clear. Several factors seem to interact to cause the disease, including abnormalities in gastrointestinal motility, visceral sensation and brain-gut regulation as well as inflammation and infection of the gastrointestinal. In addition, life stresses play a role in its pathogenesis (Enck et al., 2016). Several studies reported that university students have a higher risk of developing IBS, probably due to the psychological stresses they face during their education. Besides university studentsare more likely to follow unhealthy lifestyledue to their occupation with their studies this increases the possibility of IBS evolution and progression. Common unhealthy practices among university students include the lack of physical exercise, irregular eating habits, higher consumption of fatty junk foods and smoking (Yang et al., 2022). Medical students have a higher prevalence rate of IBS than non-medical students (Lovell and Ford, 2012; AlButaysh et al., 2020; Yang et al., 2022). This could be explained by the longer duration of study as well asstresses caused by the burden of their demanding academic education and clinical practice (Mao et al., 2019).

Although IBS is not a fatal disease, severe consequences may ensue if not detected and treated. Chronic illnesses were linked to IBS including headaches, chronic pain in the back and neck, diabetes mellitus (Grover et al., 2021), anxiety, depression (Frändemark et al., 2018) and sleep disturbances (Wang et al., 2018). All these effects could result in reduced academic achievements and increased economic burden due to the costs of diagnosis and treatment (Canavan et al., 2014; Alsuwailm et al., 2017; Frändemark et al., 2018). The diagnosis of IBS depends on several criteria, among which the RomeIII (Drossman, 1999; Ford et al., 2013) and Rome IV (Drossman and Hasler, 2016) criteria are the most commonly used.

The estimation of the prevalence of IBS and its risk factors is important to devise effective strategies to diagnoseand manage the condition before it negatively impacts the patients. Although the prevalence rate of IBS has been estimated by previous studies in Saudi Arabia (Al-bukhari et al., 2016; Alaqeel et al., 2017; Alsuwailm et al., 2017; AlButaysh et al., 2020) no such studies were carried out in the Tabuk region. Therefore, the current research work was conducted among medical students and interns at Tabuk University, Saudi Arabia to estimate the prevalence of IBS and investigate its relation to the participants' characteristics.

2. METHODS

Study design and settings

This cross-sectional, questionnaire-based study was conducted among medical students and interns at Tabuk University, Saudi Arabia during June and July2021. Ethical approval was obtained from the Ethics Committee of the University of Tabuk, Saudi Arabia. The aim of the study was explained at the beginning of the questionnaire and a question asked for consent to participate in the study. The confidentiality of the participants was ensured by the investigators.

Eligibility criteria

Eligible participants included medical students (from the second up to the sixth academic years) and interns of both sexes at Tabuk University. First-year students were not included as we wanted to examine IBS prevalence and associated factors in students and interns after experiencing the stresses of medical education and training. Medical students and interns from other universities or non-medical students were not invited to participate and were not included in the study. In addition, we excluded any student with any other diagnosed gastrointestinal conditions.

Data collection

The study devised a questionnaire to collect data using Google Forms. The targeted population was medical students and interns at Tabuk University, Saudi Arabia. The participants were invited using phone text messages, e-mails and specific groups (for Tabuk medical students) on social media platforms. The semi-structured questionnaire consisted of closed questions arranged in the following sections: Personal data (age, sex, academic level, body weight and height and family history of IBS or celiac disease), red flag signs of colorectal cancer (unexplained loss of appetite or weight, blood in stools and night sweats), the Rome III criteria, the Hospital Anxiety and Depression Scale (anxiety questions, HADS-A) and lifestyle habits (e.g., sleeping hours, fibres intake and smoking).

The reported weight and height were used to calculate the body mass index (BMI) using the formula: BMI=Weight in Kg/ Height in meters^2. The participants were then categorized according to their BMI into underweight (< 18.5 Kg/m^2), normal weight (≥ 18.5 to 24.9 kg/m^2), overweight (≥ 25 to 29.9 kg/m^2) and obese (≥ 30 kg/m^2) (Weir and Jan, 2022) in this study, we preferred to use the Rome III criteria over the more recent Rome IV criteria to diagnose IBS. This choice was adopted to enable the comparison of our results to those of earlier studies as most of them used the Rome III criteria. The Rome III diagnostic criteria for IBS depend on experiencing symptoms for the last 3 months with symptom onset 6 months before diagnosis. The criteria include experiencing recurrent pain or discomfort in the abdomen for 3 days per month during the last 3 months, associated with two criteria (at least) of the following: Improvement with defecation, onset associated with a change in stool frequency and onset associated with a change in stool form (Drossman, 1999; Ford et al., 2013). The questions were tailored to reflect these criteria and each participant was assessed for the fulfilment of the diagnostic requirements.

The HADS questionnaire is a self-administered tool used to screen for depression and anxiety in a variety of settings (e.g., community, primary care, in hospital and psychiatry). The tool is available in several languages, including Arabic and it consists of 14 items, seven for depression and seven for anxiety. The anxiety questions only were used in the present study. The seven items for anxiety include two for autonomic anxiety (panic and butterflies in the stomach) and five for tension and restlessness. Each item is rated on a 4-point scale and the ratings are added to obtain a total score ranging from 0 to 21 (0 to 7, within normal; 8to10, borderline; ≥ 11, anxiety disorder) (Zigmond and Snaith, 1983).

Statistical analysis

Microsoft Excel was used for data entry, cleaning and coding. The Excel datasheet was imported for data analysis into the SPSS (Statistical Package for Social Sciences), version 26 for Windows (IBM Corp., Armonk, N.Y., USA). Frequency and percentage were used for describing the categorical variables while the median and range (minimum to maximum values) were used for summarizing the HADS-A score. Pearson's Chi-Square test was used to assess the association between the presence of IBS and the participants' characteristics. A multivariate binomial logistic regression analysis was conducted to identify the independent risk factors for IBS. A p-value lower or equal to 0.05 was selected to interpret the significance of statistical tests.

3. RESULTS

Out of the invited 350 medical students and interns, 321 responded to the questionnaire, giving a response rate of 91.7%. Respondents who reported any of the red flag symptoms of colorectal cancer (n = 106) were excluded from the study. Among the included 215 respondents, the most frequent age was 23 years (28.4%), followed by the age of 22 years (18.1%). The percentage of female participants was slightly higher than male participants (52.6% vs. 47.4%). Nearly one-third were in the sixth year or internship and one-quarter of the participants were in the fifth year. About half the participants had normal BMI, while underweight, overweight and obese respondents accounted for 4.7, 18.1 and 15.3%, respectively. Nearly half the respondents had a family history of IBS, while only 8.4% had a family history of celiac disease. Smokers accounted for 15.8% of the participants. More than half the participants had sleep duration of 6 – 8 hours, while 19.1% slept less than six hours. Half the participants consumed fibres always or usually, while 31.6% and 15.3% either consumed fibres sometimes or rarely, respectively (Table 1). Table 2 shows the participants' responses to the questions assessing the IBS Rome III criteria. From the responses, 49 (22.8%) respondents had IBS, while 166 (77.2%) did not fulfil the criteria for diagnosing IBS (Figure 1).

The responses to the HADS-A questionnaire are presented in Table 3. The score was calculated, showing a median value of 4 and a range from 0 to 15. The interpretation of the score results showed that 155 (72.1%) participants were normal (score = 0–7), while 40 (18.6%) and 20 (9.3%) participants were borderline (score= 8–10) and had anxiety disorder (score ≥11), respectively (Figure 2). The association between the presence of IBS and the participants' characteristics and anxiety was assessed (Table 4). A significantly higher percentage of participants with IBS were female (69.4 vs. 47.6%, p = 0.007), had a family history of IBS (77.6 vs. 39.8%, p<0.001) and had celiac disease (20.4 vs. 4.8%, p = 0.002), as well as having a sleep duration less than six hours per day (44.9 vs. 11.4%, p<0.001) and scoring 8- 10 (borderline: 36.7 vs. 13.3%) or ≥11 (anxiety disorder: 20.4 vs. 6%) on the HADS-A questionnaire (p<0.001).

To assess the effects of potential factors on the occurrence of IBS in the respondents, we conducted multivariate binomial regression analysis (Table 5). The factors that had a p-value below 0.1 in Table 4 were entered into the model. The likelihood of IBS significantly increased with an IBS family history (OR: 3.583, 95% CI: 1.518 to 8.460, p = 0.004) and celiac disease (OR: 3.896, 95% CI: 1.124 to 13.507, p = 0.032), sleeping less than six hours (OR: 11.288, 95% CI: 2.956 to 43.106, p < 0.001) and higher HADS-A score (for each increase by one point: OR: 1.194, 95% CI: 1.068 to 1.336, p = 0.002).

Table 1 Characteristics and lifestyle of the respondents (total n = 321).

Characteristics		Total n = 321
Age, year	19	16 (5.0%)
	20	47 (14.6%)
	21	42 (13.1%)
	22	55 (17.1%)
	23	79 (24.6%)
	24	44 (13.7%)
	Above 24	38 (11.8%)
Gender	Male	126 (39.3%)
	Female	195 (60.7%)
Academic year	2nd year	32 (10.0%)
	3rd year	56 (17.4%)
	4th year	54 (16.8%)
	5th year	77 (24.0%)
	6th year or Internship	102 (31.8%)
Body mass index	Not calculated	52 (16.2%)
	Underweight (< 18.5 kg/m^2)	21 (6.5%)
	Normal (≥ 18.5 to 24.9 kg/m^2)	149 (46.4%)
	Overweight (≥ 25 to 29.9 kg/m^2)	56 (17.4%)
	Obesity (≥ 30 kg/m^2)	43 (13.4%)
Family history of irritable bowel syndrome	Yes	161 (50.2%)
	No	116 (36.1%)
	I don't know.	44 (13.7%)
Family history of celiac disease	Yes	42 (13.1%)
	No	242 (75.4%)
	I don't know	37 (11.5%)
Do you smoke?	No response	6 (1.9%)
	No	262 (81.6%)
	Yes	53 (16.5%)
How much do you usually sleep?	No response	4 (1.2%)
	Less than 6 hours	65 (20.2%)
	6-8 hours	178 (55.5%)
	More than 8 hours	74 (23.1%)
How often do you take fibres in your diet? (Like vegetables, fruits, and whole-grain bread)	No response	4 (1.2%)
	Always	73 (22.7%)
	Usually	92 (28.7%)
	Sometimes	107 (33.3%)
	Rarely	45 (14.0%)

Table 2 Responses to questions assessing the ROME III criteria for diagnosing irritable bowel syndrome (total n = 321).

ROME III criteria		Total n = 321
In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen?	No response	1 (0.3%)
	Never	61 (19.0%)
	Less than one day a month	77 (24.0%)
	One day a month	39 (12.1%)
	Two to three days a month	49 (15.3%)
	One day a week	44 (13.7%)

	More than one day a week	40 (12.5%)
	Every day	10 (3.1%)
Have you had this discomfort or pain for 6 months or longer?	No response	8 (2.5%)
	No	176 (54.8%)
	Yes	137 (42.7%)
How often did this discomfort or pain get better or stop after you had a bowel movement?	No response	8 (2.5%)
	Never or rarely	73 (22.7%)
	Sometimes	105 (32.7%)
	Often	46 (14.3%)
	Most of the time	60 (18.7%)
	Always	29 (9.0%)
When this discomfort or pain started, did you have more frequent bowel movements?	No response	8 (2.5%)
	Never or rarely	110 (34.3%)
	Sometimes	106 (33.0%)
	Often	58 (18.1%)
	Most of the time	21 (6.5%)
	Always	18 (5.6%)
When this discomfort or pain started, did you have less frequent bowel movements?	No response	8 (2.5%)
	Never or rarely	134 (41.7%)
	Sometimes	116 (36.1%)
	Often	30 (9.3%)
	Most of the time	27 (8.4%)
	Always	6 (1.9%)
When this discomfort or pain started, were your stools (bowel movements) looser?	No response	8 (2.5%)
	Never or rarely	119 (37.1%)
	Sometimes	94 (29.3%)
	Often	54 (16.8%)
	Most of the time	39 (12.1%)
	Always	7 (2.2%)
When this discomfort or pain started, how often did you have harder stools?	No response	9 (2.8%)
	Never or rarely	135 (42.1%)
	Sometimes	101 (31.5%)
	Often	45 (14.0%)
	Most of the time	25 (7.8%)
	Always	6 (1.9%)
In the last 3 months, how often did you have hard or lumpy stools?	No response	6 (1.9%)
	Never or rarely	134 (41.7%)
	About 25% of the time	86 (26.8%)
	About 50% of the time	56 (17.4%)
	About 75% of the time	32 (10.0%)
	Always, 100% of the time	7 (2.2%)
In the last 3 months, how often did you have loose, mushy, or watery stools?	No response	5 (1.6%)
	Never or rarely	141 (43.9%)
	About 25% of the time	91 (28.3%)
	About 50% of the time	42 (13.1%)
	About 75% of the time	36 (11.2%)
	Always, 100% of the time	6 (1.9%)

Table 3 Responses to HADS criteria and some symptoms (total n = 321).

Symptoms		Total n = 321
Presence of symptoms	Yes	106 (33.0%)
	No	215 (67.0%)
Night sweat	Yes	37 (11.5%)
	No	284 (88.5%)
Unexplained loss of weight	Yes	39 (12.1%)
	No	282 (87.9%)
Unexplained loss of appetite	Yes	59 (18.4%)
	No	262 (81.6%)
Blood in the stools	Yes	20 (6.2%)
	No	301 (93.8%)
HADS		
I feel tense or 'wound' up*	No response	5 (1.6%)
	A. Most of the time	27 (8.4%)
	B. A lot of the time	44 (13.7%)
	C. From time to time, occasionally	82 (25.5%)
	D. Not at all	163 (50.8%)
I get a sort of frightened feeling as if something awful is about to happen	No response	7 (2.2%)
	A. Not at all	164 (51.1%)
	B. Occasionally	91 (28.3%)
	C. Quite Often	45 (14.0%)
	D. Very Often	14 (4.4%)
Worrying thoughts go through my mind	No response	7 (2.2%)
	A. A great deal of the time	51 (15.9%)
	B. A lot of the time	82 (25.5%)
	C. From time to time, but not too often	79 (24.6%)
	D. Only occasionally	102 (31.8%)
I can sit at ease and feel relaxed	No response	6 (1.9%)
	A. Definitely	85 (26.5%)
	B. Usually	128 (39.9%)
	C. Not Often	61 (19.0%)
	D. Not at all	41 (12.8%)
I get a sort of frightened feeling like 'butterflies' in the stomach	No response	5 (1.6%)
	A. Not at all	159 (49.5%)
	B. Occasionally	94 (29.3%)
	C. Quite Often	45 (14.0%)
	D. Very Often	18 (5.6%)
I feel restless as if I have to be on the move	No response	12 (3.7%)
	A. Very much indeed	40 (12.5%)
	B. Quite a lot	65 (20.2%)
	C. Not very much	84 (26.2%)
	D. Not at all	120 (37.4%)
I get sudden feelings of panic	No response	5 (1.6%)
	A. Very often indeed	24 (7.5%)
	B. Quite often	60 (18.7%)

	C. Not very often	72 (22.4%)
	D. Not at all	160 (49.8%)

Table 4 Association of irritable bowel syndrome with the respondents' characteristics, suffered symptoms and anxiety (HADS-A score) (total n = 321).

		No IBS (n = 227)	IBS (n = 94)	Test statistic	P-value
Age, year	19	11 (4.8%)	5 (5.3%)	9.563 a	0.141
	20	26 (11.5%)	21 (22.3%)		
	21	34 (15.0%)	8 (8.5%)		
	22	40 (17.6%)	15 (16.0%)		
	23	58 (25.6%)	21 (22.3%)		
	24	34 (15.0%)	10 (10.6%)		
	Above 24	24 (10.6%)	14 (14.9%)		
Gender	Male	101 (44.5%)	25 (26.6%)	8.900 b	0.002*
	Female	126 (55.5%)	69 (73.4%) $+		
Academic year	2nd year	23 (10.1%)	9 (9.6%)	15.897 b	0.003*
	3rd year	32 (14.1%)	24 (25.5%) $+		
	4th year	49 (21.6%) $+	5 (5.3%)		
	5th year	52 (22.9%)	25 (26.6%)		
	6th year or Internship	71 (31.3%)	31 (33.0%)		
Body mass index	Not calculated	40 (17.6%)	12 (12.8%)	2.135 b	0.711
	Underweight	15 (6.6%)	6 (6.4%)		
	Normal	105 (46.3%)	44 (46.8%)		
	Overweight	36 (15.9%)	20 (21.3%)		
	Obesity	31 (13.7%)	12 (12.8%)		
Family history of irritable bowel syndrome	Yes	97 (42.7%)	64 (68.1%) $+	26.184 b	<0.001*
	No	102 (44.9%) $+	14 (14.9%)		
	I don't know.	28 (12.3%)	16 (17.0%)		
Family history of celiac disease	Yes	24 (10.6%)	18 (19.1%) $+	9.575 b	0.008*
	No	182 (80.2%) $+	60 (63.8%)		
	I don't know	21 (9.3%)	16 (17.0%)		
Presence of symptoms	Yes	61 (26.9%)	45 (47.9%)	13.254 b	<0.001*
	No	166 (73.1%)	49 (52.1%)		
Night sweat	Yes	20 (8.8%)	17 (18.1%)	5.607 b	0.018*
	No	207 (91.2%)	77 (81.9%)		
Unexplained loss of weight	Yes	23 (10.1%)	16 (17.0%)	2.956 b	0.086
	No	204 (89.9%)	78 (83.0%)		
Unexplained loss of appetite	Yes	32 (14.1%)	27 (28.7%)	9.480 b	0.002*
	No	195 (85.9%)	67 (71.3%)		
Blood in the stools	Yes	12 (5.3%)	8 (8.5%)	1.183 b	0.277
	No	215 (94.7%)	86 (91.5%)		
Do you smoke?	No response	4 (1.8%)	2 (2.1%)	0.418 a	0.835
	No	184 (81.1%)	78 (83.0%)		
	Yes	39 (17.2%)	14 (14.9%)		
How much do you usually sleep?	No response	3 (1.3%)	1 (1.1%)	17.017 a	<0.001*
	< than 6 hours	32 (14.1%)	33 (35.1%) $+		
	6-8 hours	136 (59.9%)	42 (44.7%)		

	> than 8 hours	56 (24.7%)	18 (19.1%)		
How often do you take fibres in your diet? (Like vegetables, fruits, and whole-grain bread)	No response	3 (1.3%)	1 (1.1%)	1.438 a	0.870
	Always	54 (23.8%)	19 (20.2%)		
	Usually	66 (29.1%)	26 (27.7%)		
	Sometimes	75 (33.0%)	32 (34.0%)		
	Rarely	29 (12.8%)	16 (17.0%)		
HADS-A	Normal	149 (66.8%) $+	32 (34.4%)	28.734 b	<0.001*
	Borderline	42 (18.8%)	31 (33.3%) $+		
	Anxiety disorder	32 (14.3%)	30 (32.3%) $+		

a: Fisher-Freeman-Halton exact test; b: Pearson's Chi-square test for independence of observations; * significant at p<0.05; $+: significantly higher than expected by chance (According to adjusted residuals)

Table 5 Multivariate binomial logistic regression analysis to assess factors contributing to IBS among the respondents

Independent variables	Reference category	p-value	OR	95% CI for OR
Female gender	Male	0.064	1.803	0.967 to 3.364
Academic year		0.003*		
3rd year	2nd year	0.366	1.623	0.567 to 4.645
4th year	2nd year	0.013*	0.192	0.052 to 0.705
5th year	2nd year	0.273	1.790	0.632 to 5.068
6th year or Internship	2nd year	0.608	1.302	0.475 to 3.565
Family history of IBS (yes)	No	0.009*	2.173	1.218 to 3.876
Family history of celiac disease	No	0.804	1.107	.495 to 2.476
Presence of symptoms (yes)	No	0.052	1.900	0.995 to 3.627
Sleep duration		0.019*		
< than 6 hours	> 8 hours	0.017*	2.734	1.200 to 6.229
6-8 hours	> 8 hours	0.739	1.131	0.548 to 2.333
HADS-A interpretation		0.008*		
Borderline	Normal	0.003*	2.959	1.449 to 6.041
Anxiety disorder	Normal	0.039*	2.222	1.041 to 4.740

CI: confidence interval; OR: odds ratio; * significant at p<0.05

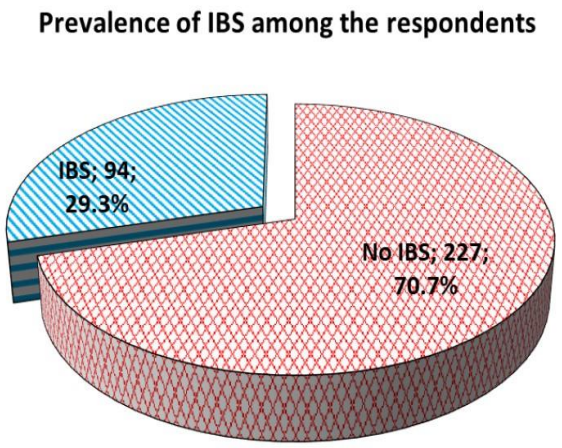

Figure 1 Prevalence of IBS among the respondents in the present study according to ROME III criteria)

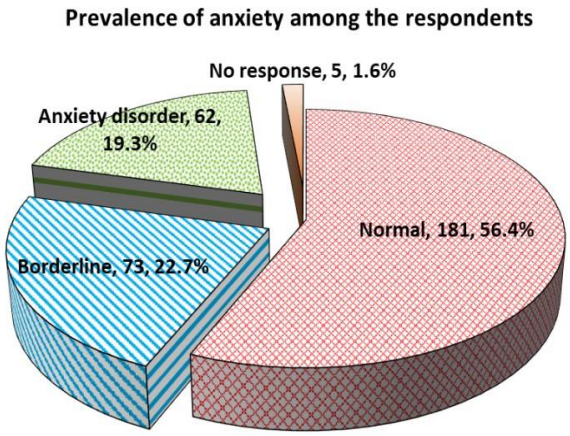

Figure 2 Prevalence of anxiety among the respondents in the present study according to the results of the HADS-A questionnaire.

4. DISCUSSION

The present study aimed to estimate the prevalence of IBS and assessits association with the participants' characteristics among medical students and interns at Tabuk University, Saudi Arabia. The study included 215 participants. The prevalence of IBS among our sample was 22.8% according to the Rome III criteria. A similar rate of 21%was reported in a study at King Saud bin Abdulaziz University in Riyadh, Saudi Arabia (Alaqeel et al., 2017). Other approximate rates were reported in the literature, such as 20.5% in Canada (Wells et al., 2012), 27.5% in Egypt (El Sharawy et al., 2022) and 27.2% in Sudan (Eltayeb, 2020). Even higher rates were reported, ranging from 29% in Egypt (Elhosseiny et al., 2019) and Jordan (Jadallah et al., 2022) up to 44.5%in Al-Hasa, Saudi Arabia (Alsuwailm et al., 2017). On the other hand, much lower rates were reported in Nigeria (14.4%) (Jemilohun et al., 2018) all the aforementioned studies utilized Rome III criteria for the diagnosis of IBS. We did not compare our results to thoseof studies using older versions of the Rome criteria or the more recent version (Rome VI) as wide variations exist with the use of each tool. The Rome IV criteria tend to cause lower rates of IBS as it requires for diagnosis that abdominal pain occurs at least 1 day per week compared to the Rome III criteria that demand 3 days per month (Whitehead et al., 2017).

The discrepancies across the studies that used the same criteria for diagnosing IBS could be explained by the differences in the populations from which the sampleswere drawn regarding their culture, climate, dietary habits, socioeconomic stresses and academic burden (Yang et al., 2022). We found that most participants were female with a significant association of IBS with female gender (69.4 vs. 47.6%, $p = 0.007$) on univariate analysis. However, this association was not significant in adjusting for confounders in multivariate analysis. This finding is supported by results of other studies that showed a lack of significant gender predominance in patients with IBS, both in medical students (Muneer et al., 2017; El Sharawy et al., 2022) and the general public (Black and Ford, 2020; Palsson et al., 2020). On the other hand, several studies reported significantly higher rates of IBS in females compared to male students in Saudi Arabia, Jordan, Egypt and Nigeria (Alsuwailm et al., 2017; Ibrahim et al., 2018; Jemilohun et al., 2018; Elhosseiny et al., 2019; Jadallah et al., 2022). Meanwhile, a higher prevalence in male medical students was reported by an earlier study in Saudi Arabia (Wani et al., 2020) and another study in Malaysia (Seger et al., 2020).

Studies that found a higher rate in female subjects explained their findings by the relaxing effect ofestrogenon the colonic smooth muscles and the activation of mast cells, which augments the sensitization of the intestinal nerves. Moreover, increased prostaglandins during menses might cause diarrhoea by enhancing intestinal secretions. Another explanation is that females are more prone to sufferfrom life stresses and develop anxiety, which is a risk factor for IBS (Yang et al., 2022). About half the participants had a family history of IBS, while 8.4% had a family history of celiac disease. The univariate analysis showed that IBS was significantly associated with anIBS family history (77.6 vs. 39.8%, $p<0.001$) and celiac disease (20.4 vs. 4.8%, $p = 0.002$). Moreover, multivariate analysis revealed a significant increase in risk with an IBS family history (OR: 3.583, 95% CI: 1.518 to 8.460, $p = 0.004$) and celiac disease (OR: 3.896, 95% CI: 1.124 to 13.507, $p = 0.032$). This finding is consistent with several previous studies that found family history of IBS to represent a significant risk factor in medical students fromSaudi Arabia (Alsuwailm et al., 2017), Egypt (Elhosseiny et al., 2019) and Jordan (Jadallah et al., 2022). Earlier studies from Sweden and the United States revealed the responsibility of genetic factors in the familial clustering of IBS (Saito et al., 2010; Waehrens et al., 2015). Conversely, a study from Egypt found no association between family history and IBS (El Sharawy et al., 2022).

The associations between IBS and celiac disease have been investigated by other studies outside the scope of medical students, with conflicting results. In general, there seems to be a larger prevalence of familial history of celiac disease in IBS patients than in healthy cohorts. The symptoms of both conditions are similar and may overlap (Leeds and Sanders, 2007). One-fifth of the participants used to sleep less than six hours dailyand this was significantly associated with the presence of IBS on univariate (44.9 vs. 11.4%, p<0.001) and multivariate analysis (OR: 11.288, 95% CI: 2.956 to 43.106, p < 0.001). A significant association between poor sleep and IBS was reported among medical students in Saudi Arabia (Ibrahim et al., 2018) and Jordan (Jadallah et al., 2022). However, such an association was not elicited by other studies in Saudi Arabia (Alsuwailm et al., 2017), Egypt (El Sharawy et al., 2022) and Malaysia (Seger et al., 2020). Poor sleep can negatively affect the patients' cognition, emotion and gastrointestinal function. The disturbed biological rhythm can alter visceral motility and sensitivity, which in turn would change the colonic physiological function (Liu et al., 2014).

In the present study, the likelihood of IBS was significantly higher on univariate analysis in those having borderline (36.7 vs. 13.3%, p< 0.001) or definite anxiety disorder (20.4 vs. 6%, p < 0.001) on the HADS-A questionnaire. On multivariate analysis, an increase of HADS-A by one point was coupled withan increase in the likelihood of IBS by 1.194 times (95% CI: 1.068 to 1.336, p = 0.002). The findings of previous studies among medical students corroborate this association between anxiety and IBS in various countries (Alsuwailm et al., 2017; Elhosseiny et al., 2019; El Sharawy et al., 2022; Jadallah et al., 2022). This association has been also found by a meta-analysis of the general population (Fond et al., 2014).

The mechanism by which stressimpacts IBS is not yet defined but is assumed to be caused by a disturbance of the gut-brain axis (Qin et al., 2014). Treatment of anxiety symptoms is expected to improve the patient's condition and reduce the rate of IBS and its effect on the quality of life. Meanwhile, the relationship between IBS and anxiety may be bidirectional, with anxiety causing IBS and IBS leading to increased sensations of anxiety and depression due to its effect on the patients' academic achievements and life quality. Some factors were not found to have a significant contribution to the presence of IBS among the medical students in this study, including academic level, BMI, fiber consumption and smoking.

We found a trend of increased prevalence of IBS at the higher academic level; however, this trend was not statistically significant and the prevalence was noticeably lower among fourth-year students. Likewise, a lack of significant association was also reported by studies on medical students in several countries including Saudi Arabia (Alsuwailm et al., 2017), Egypt (Elhosseiny et al., 2019; El Sharawy et al., 2022) and Canada (Wells et al., 2012). On the contrary, some studies have found a higher predisposition of certain academic year medical students to have IBS. Jadallah et al., (2022) reported that second and third-year Jordanian medical students were at higher risk compared to first year and fourth to sixth year students. We did not find a significant association between BMI and IBS, which was similar to several previous studies (Alsuwailm et al., 2017; Elhosseiny et al., 2019; Jadallah et al., 2022).

As regardsdiet, several studies like our results did not find a significant impact on IBS ratesin Saudi Arabia, Egypt and Jordan (Alsuwailm et al., 2017; Elhosseiny et al., 2019; Wani et al., 2020; Jadallah et al., 2022). On the other hand, other studies stressed the relationship between IBS and diet in medical students in various countries including Egypt (El Sharawy et al., 2022) and China (Jia et al., 2022). This discrepancy could be attributed to the variations in regional and cultural backgrounds, which affect the type of diet and thus the weight of its impact on the development of IBS. Consistent with our findings, smoking was not a risk factor for IBS in two Egyptian studies (Elhosseiny et al., 2019; El Sharawy et al., 2022). However, an earlier study from Saudi Arabia found a significant relation with smoking in medical students (Murad et al., 2019). The lack of a significant link between smoking and IBS in our study could be attributed to the lower rate of smokers in our sample.

The present study is unprecedented in the region of Tabuk and provided an insight into IBS and its prevalence in medical students at Tabuk University along with highlighting the associated risk factors that should be addressed to alleviate the suffering of those patients. The study has some limitations as the use of a self-administered questionnaire mayresult in a higherrate of missed and inaccurate data than that obtained by interviewing the participants. In addition, no clinical examination orinvestigations were performed to exclude organic causes for the symptoms suffered by the respondents before reverting to a diagnosis of IBS. Moreover, the sample was convenientand not randomized. Therefore, only motivated students responded to the questionnaire, probably because they suffered from IBS like symptoms and this may introduce bias and over estimate the prevalence of IBS.

5. CONCLUSION

Among medical students and interns at Tabuk University IBS showed a prevalence of 22.8%. The detected independent preventable risk factors were sleeping less than 6 hours daily and having an anxiety disorder. Further research is recommended to investigate the impact of IBS on the students' academic achievements as well as the health professionals' clinical performance.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Majed Alshehri, Jalawi Alotaibi, Faisal Alharthi, Abdulaziz Albalawi and Mohammed Alghamdi. The first draft of the manuscript was prepared by Abdulrahman Albalawi, Yazeed Alwabisi, Bander Abu Murad and Waleed Alshammari and it was revised by Hyder Mirghani and Mohammed Bin Ibrahim. All authors have read and approved the final manuscript.

Conflict of interests

The authors declare that they have no conflicts of interest.

Ethical approval

Ethical clearance was thought from the ethical committees of the University of Tabuk (number, UT-212-63-2022, dated 29-5-2022).

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Alaqeel MK, Alowaimer NA, Alonezan AF, Almegbel NY, Alaujan FY. Prevalence of irritable bowel syndrome and its association with anxiety among medical students at King Saud bin Abdulaziz University for Health Sciences in Riyadh. Pak J Med Sci 2017; 33:33-6. https://doi.org/10.1266 9 /pjms.331.12572
2. Al-bukhari I, Al-Malki K, Kashkari M, Alrifai A, Adnan M. Prevalence and factors affecting irritable bowel syndrome among medical students at Taibah University. Clin Med Res 2016; 5:1-5. https://doi.org/10.11648/j.cmr.20160501.11
3. AlButaysh OF, AlQuraini AA, Almukhaitah AA, Alahmdi YM, Alharbi FS. Epidemiology of irritable bowel syndrome and its associated factors in Saudi undergraduate students. Saudi J Gastroenterol 2020; 26:89-93. https://doi.org/10.4103/ sjg.SJG_459_19
4. Alsuwailm W, AL-Qahtani M, AL-Hulaibi A, AL-Hadi M, Busa'ad W, Ali S, Shehabeldeen S. Irritable bowel syndrome among medical students and interns in King Faisal University. Open J Prev Med 2017; 7:235-46. https://doi.org/ 10.4236/ojpm.2017.711019
5. Black CJ, Ford AC. Global burden of irritable bowel syndrome: Trends, predictions and risk factors. Nat Rev Gastroenterol Hepatol 2020; 17:473-86. https://doi.org/10.10 38/s41575-020-0286-8
6. Canavan C, West J, Card T. Review article: The economic impact of the irritable bowel syndrome. Aliment Pharmacol Ther 2014; 40:1023-34. https://doi.org/10.1111/ apt.12938
7. Drossman DA, Hasler WL. Rome IV-functional gi disorders: Disorders of gut-brain interaction. Gastroenterol 2016; 150:1 257-61. https://doi.org/10.1053/j.gastro.2016.03.035
8. Drossman DA. The functional gastrointestinal disorders and the Rome II process. Gut 1999; 45(2):5. https://doi.org/10.113 6/gut.45.2008.ii1
9. El Sharawy SM, Amer IF, Elkadeem MZ. Irritable bowel syndrome in Egyptian medical students, prevalence and associated factors: A cross-sectional study. Pan Afr Med J 2022; 41:311. https://doi.org/10.11604/pamj.2022.41.311.28228
10. Elhosseiny D, Mahmoud NE, Manzour AF. Factors associated with irritable bowel syndrome among medical students at Ain Shams University. J Egypt Public Health Assoc 2019; 94:23. https://doi.org/10.1186/s42506-019-0023-8
11. Eltayeb LB. A questionnaire-based survey on irritable bowel syndrome among medical and non-medical students at Al-Neelain University, Khartoum, Sudan. J Biochem Technol 2020; 11:43-8.
12. Enck P, Aziz Q, Barbara G, Farmer AD, Fukudo S, Mayer EA, Niesler B, Quigley EMM, Rajilić-Stojanović M, Schemann M, Schwille-Kiuntke J, Simren M, Zipfel S, Spiller RC. Irritable bowel syndrome. Nat Rev Dis Primers 2016; 2:16014. https://doi.org/10.1038/nrdp.2016.14
13. Fond G, Loundou A, Hamdani N, Boukouaci W, Dargel A, Oliveira J, Roger M, Tamouza R, Leboyer M, Boyer L. Anxiety and depression comorbidities in irritable bowel syndrome (IBS): A systematic review and meta-analysis. Eur

Arch Psychiatry Clin Neurosci 2014; 264:651-60. https://doi.org/10.1007/s00406-014-0502-z

14. Ford AC, Bercik P, Morgan DG, Bolino C, Pintos-Sanchez MI, Moayyedi P. Validation of the Rome III criteria for the diagnosis of irritable bowel syndrome in secondary care. Gastroenterol 2013; 145:1262-70.e1 https://doi.org/10.1053/j.gastro.2013.08.048
15. Frändemark Å, Törnblom H, Jakobsson S, Simrén M. Work productivity and activity impairment in irritable bowel syndrome (IBS): A multifaceted problem. Am J Gastroenterol 2018; 113:1540-9http://doi.org/10.1038/s41395-018-0262-x
16. Grover M, Kolla BP, Pamarthy R, Mansukhani MP, Breen-Lyles M, He J-P, Merikangas KR. Psychological, physical and sleep comorbidities and functional impairment in irritable bowel syndrome: Results from a national survey of U.S. adults. PLOS ONE 2021; 16:e0245323. https://doi.org/10.1371/journal.pone.0245323
17. Ibrahim NK, Al-Jamhoor S, Ashour N, Alsulami A, Bukhari D, Al-bloshi A, Fathi T. Irritable bowel syndrome among paramedical students, King Abdulaziz University, Jeddah, Saudi Arabia. Gastroenterol Hepatol Endosc 2018; 3:1-5. https://doi.org/10.15761/GHE.1000151
18. Jadallah KA, Khatatbeh MM, Sarsak EW, Sweidan AN, Alzubi BF. Irritable bowel syndrome and its associated factors among Jordanian medical students: A cross-sectional study. Medicine (Baltimore) 2022; 101:e30134 https://doi.org/10.1097/md.0000000000030134
19. Jemilohun AC, Abayomi O, Adebayo PB. Prevalence of irritable bowel syndrome, psychological ill-health and health-seeking behavior in a population of Nigerian Medical Students. J Adv Med Res 2018; 25:1-9.
20. Jia W, Liang H, Wang L, Sun M, Xie X, Gao J, Li L, Tang X, Ma Y. Associations between abnormal eating styles and irritable bowel syndrome: A cross-sectional study among medical school students. Nutrients 2022; 14. https:/doi.org/10.3390/nu14142828
21. Leeds JS, Sanders DS. Is there an association between coeliac disease and irritable bowel syndrome? Gut 2007; 56:1326-7.
22. Liu Y, Liu L, Yang Y, He Y, Zhang Y, Wang M, Chen S, Yao S. A school-based study of irritable bowel syndrome in medical students in Beijing, china: Prevalence and some related factors. Gastroenterol Res Pract 2014; 2014:124261. https://doi.org/10.1155/2014/124261
23. Lovell RM, Ford AC. Global prevalence of and risk factors for irritable bowel syndrome: A meta-analysis. Clin Gastroenterol Hepatol 2012; 10:712-21.e4 https://doi.org/10.1016/j.cgh.2012.02.029
24. Mao Y, Zhang N, Liu J, Zhu B, He R, Wang X. A systematic review of depression and anxiety in medical students in China. BMC Med Educ 2019; 19:327. https://doi.org/10.1186/s12909-019-1744-2
25. Muneer A, Moayad A, Abdullah A, Mohannad A, Moeen Z. Prevalence of irritable bowel syndrome and its associated factors among medical students. Int J Med Res Health Sci 2017; 6:1-10.
26. Murad MA, Abousada HJ, Zamzami YM, Alkaf MA, Sagga BKM, Alhrany AN, Alhrany AN, Bredy GI, Alhawsawi MZ. Prevalence and risk factors of irritable bowel syndrome among medical students. Int J of Adv Res 2019; 7:1008-16. http://doi.org/10.21474/IJAR01/10246
27. Palsson OS, Whitehead W, Törnblom H, Sperber AD, Simren M. Prevalence of Rome IV functional bowel disorders among adults in the United States, Canada and the United Kingdom. Am J Gastroenterol 2020; 158:1262-73.e3 https://doi.org/10.1053/j.gastro.2019.12.021
28. Qin HY, Cheng CW, Tang XD, Bian ZX. Impact of psychological stress on irritable bowel syndrome. World J Gastroenterol 2014; 20:14126-31. https://doi.org/10.3748/wjg.v20.i39.14126
29. Saito YA, Petersen GM, Larson JJ, Atkinson EJ, Fridley BL, de Andrade M, Locke RG, III, Zimmerman JM, Almazar-Elder AE, Talley NJ. Familial aggregation of irritable bowel syndrome: a family case–control study. Am J Gastroenterol 2010; 105:833-41 http://doi.org/10.1038/ajg.2010.116
30. Schoenfeld PS. Advances in IBS 2016: A review of current and emerging data. Gastroenterol Hepatol 2016; 12:1-11.
31. Seger S, Nasharuddin NNB, Fernandez SL, Yunus S, Shun NTM, Agarwal P, Burud I. Prevalence and factors associated with irritable bowel syndrome among medical students in a Malaysian private university: A cross sectional study. Pan Afr Med J 2020; 37:151. https://doi.org/10.11604/pamj.2020.37.151.21716
32. Sperber AD, Dumitrascu D, Fukudo S, Gerson C, Ghoshal UC, Gwee KA, Hungin APS, Kang J-Y, Minhu C, Schmulson M, Bolotin A, Friger M, Freud T, Whitehead W. The global prevalence of IBS in adults remains elusive due to the heterogeneity of studies: a Rome Foundation working team literature review. Gut 2017; 66:1075. https://doi.org/10.1136/gutjnl-2015-311240
33. Waehrens R, Ohlsson H, Sundquist J, Sundquist K, Zöller B. Risk of irritable bowel syndrome in first-degree, second-degree and third-degree relatives of affected individuals: A nationwide family study in Sweden. Gut 2015; 64:215-21. https://doi.org/10.1136/gutjnl-2013-305705
34. Wang B, Duan R, Duan L. Prevalence of sleep disorder in irritable bowel syndrome: A systematic review with meta-analysis. Saudi J Gastroenterol 2018; 24:141-50. https://doi.org/10.4103/sjg.SJG_603_17
35. Wani FA, Almaeen AH, Bandy AH, Thirunavukkarsu A, Al-Sayer TA, Flah A, Fayed K, Albalawi MM. Prevalence and

risk factors of ibs among medical and nonmedical students in the jouf university. Niger J Clin Pract 2020; 23:555-60. https://doi.org/10.4103/njcp.njcp_512_18

36. Weir CB, Jan A. BMI classification percentile and cut off points. In: StatPearls [Internet]. Treasure Island (FL): Stat Pearls Publishing 2022.
37. Wells M, Roth L, McWilliam M, Thompson K, Chande N. A cross-sectional study of the association between overnight call and irritable bowel syndrome in medical students. Can J Gastroenterol 2012; 26:281-4. https://doi.org/10.1155/2012/ 865915
38. Whitehead WE, Palsson OS, Simrén M. Irritable bowel syndrome: what do the new Rome IV diagnostic guidelines mean for patient management? Expert Rev Gastroenterol Hepatol 2017; 11:281-3. https://doi.org/10.1080/17474124.2017.1292130
39. Yang W, Yang X, Cai X, Zhou Z, Yao H, Song X, Zhao T, Xiong P. The prevalence of irritable bowel syndrome among Chinese university students: A systematic review and meta-analysis. Front Public Health 2022; 10. https://doi.org/10.3389/fpubh.2022.864721
40. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67:361-70. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x