



A systematic review of the prevalence and risk factors of irritable bowel syndrome among medical students

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ABSTRACT

Background/Aims: Irritable bowel syndrome (IBS) represents a great challenge to public health, particularly among medical students. The aim of the study was to determine the global prevalence and risk factors of IBS among medical students.

Materials and Methods: Data were obtained through searches in PubMed, Ovid, the Cochrane database, Embase, Google scholar, Institute for Scientific Information (ISI) "Web of Science," and Medline from 1990 to June 2015. The search terms included "Irritable Bowel Syndrome" and "Medical students" and "prevalence, risk factors". More than 100 articles were reviewed, scrutinized, and critically appraised for the eligibility criteria, and the relevant articles were selected.

Results: Sixteen studies were identified, and the prevalence of IBS among medical students ranged from 9.3% to 35.5%. The relatively high prevalence among medical students may be attributed to their special stressful learning environment. Some studies found that female gender, family history of IBS, psychiatric stress, anxiety, depression, infections, dietary factors, and sleep disorders were associated with IBS.

Conclusion: A relatively high prevalence of IBS was prevalent among medical students. Annual screening of IBS and introduction of stress management courses are recommended.

Keywords: Irritable bowel syndrome, prevalence, risk factors, medical students, systematic review

INTRODUCTION

Currently, there is a growing interest in the epidemiological and clinical researches of the functional gastrointestinal disorders (FGDs) (1). Irritable bowel syndrome (IBS) is an important type of FGDs, which remains a medical challenge in the 21st century (2). The characteristic symptoms of IBS are recurrent abdominal pain, discomfort, and changes in the stool habits in the absence of any organic disorders (2,3).

There is no confirmative investigation or biomarker for IBS diagnosis, and it is diagnosed only clinically. The criteria for the diagnosis of IBS have changed over time, from the Manning criteria in the 1970s to the Rome III criteria that is currently used (4).

Medical students are a special group characterized by tremendous cognitive and emotional changes. Furthermore, to the best of our knowledge, no compre-

hensive review (including prevalence, risk factors of IBS) has been conducted among medical students using different diagnostic criteria. No review was performed to show a difference between IBS among medical students and among the general population (5). Therefore, such a review is urgently needed.

The purpose of the study was to determine the global prevalence and risk factors of IBS among medical students by conducting a systematic review.

MATERIALS AND METHODS

Search strategy and selection criteria

Data for this review were obtained through searches in PubMed, Ovid, the Cochrane database, Embase, Google scholar, Institute for Scientific Information (ISI) "Web of Science," and Medline. The timeframe was from 1990 to June 2015. The search terms included "Irritable Bowel

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Syndrome" and "Medical students" and "prevalence or risk factors". The reference lists of identified articles and papers quoting identified articles. Cross-sectional and case-control studies were mainly searched. The eligibility criteria include medical students diagnosed to have IBS using one of the diagnostic criteria.

The eligibility criteria were article of prevalence and risk factors among medical students. More than 100 articles were reviewed, scrutinized, and critically appraised, and the most relevant articles were used. The eligibility criteria were stratified in 15 studies.

Certain calculations such as male:female ratio and calculation of certain prevalence and Odds ratio (OR) from the literature were performed by Epi Info™ 7.1.5 (Center for Disease Control and Prevention; Atlanta, Georgia, USA). The results of the systematic review studies were discussed. Rates among students with similar age and other studies among the general population were identified and used for the discussion. This was performed because of the lack of adequate studies among age- and sex-matched university students.

The study was approved by the Unit of Biomedical Ethics Committee of King Abdulaziz University, Jeddah.

RESULTS

After searching and conducting a critical appraisal of the articles, 16 studies were selected for the current systematic (2,3,5-18) review. A summary of these studies is presented in Table 1.

Prevalence of IBS among medical students from the systemic review

Irritable bowel syndrome prevalence differed greatly in the 16 studies depending on the population and the diagnostic tool (4,8,19,20). It ranged from 9.3% in the study of Dong et al. (9) from China to 35.5% in the study of Okami et al. (10) from Japan. The prevalence of IBS reported among Canadian medical students was 20.61% (11), while the corresponding rate from India was 16.5% (3). Naeem et al. (8) reported that the prevalence of IBS was 28.3% from three medical colleges in Karachi, Pakistan. Furthermore, Ibrahim et al. (2) reported a prevalence of 31.8% between medical students and interns from Jeddah, Kingdom of Saudi Arabia.

Risk factors of IBS

The following part is concerned with results related to different risk factors of IBS among medical students, obtained from the current systemic review.

➤ Gender

Table 1 shows that most of the studies conducted among medical students (2,3,5,7,8,10,12,13,15) reported that females had a higher risk of IBS than males. Liu et al. (5) showed that women were nearly two-times more likely to

report symptoms of IBS than men [OR=1.914; 95% confidence interval (CI): 1.281–2.86]. Ibrahim et al. (2) reported that the first predictor of IBS was the female gender [adjusted OR (aOR)=2.89; 95% CI: 1.65–5.05].

➤ Psychological and psychiatric factors (stress, anxiety and depression)

Several studies (2,3,5,8,10,16) evaluated the effect of stress on IBS among medical students. Tan et al. (16) found that symptoms of anxiety and depression were more commonly encountered among Malaysian medical students with IBS than others. Similarly, Okami et al. (10) found that medical students with IBS had significantly higher stress scores (anxiety and depression) and stressful life events than the non-IBS group. Ibrahim et al. (2) found that morbid anxiety is a predictor of IBS in Jeddah. They also found that 40.1% of medical students who faced an emotional stress suffered from IBS compared with 20.1% among those without such stress. Naeem et al. (8) found that the psychological symptoms of anxiety were significantly higher among IBS students than among those who did not suffer from IBS. Liu et al. (5) reported that the scores of the Child Trauma Questionnaire (CTQ) and Student-Life Stress Inventory (SLSI) were higher among Chinese medical students with IBS than among others.

➤ Infection

The study of Jeddah found that the IBS rate was higher among medical students who complained from travelers' diarrhea (40.8%) than others (30.8%). However, the difference did not reach statistical significance (2).

➤ Familial factors

It was found from Jeddah's study that medical students who had a family history of IBS were approximately two times more likely to report IBS than others (2).

➤ Diet

Dietary factors associated with IBS from the systematic review were as follows

a) Allergy & food hypersensitivity

Ibrahim et al. (2) found that the prevalence of IBS was much higher among medical students who had a history of food hypersensitivity than others. Furthermore, the study of Costanian et al. (6) found that one-quarter of IBS cases reported that foods triggered diarrhea or abdominal pain.

b) Dietary constituents

Basandra et al. (3) found that IBS had significant associations with consumption of fatty food among medical students from Northern India. Similarly, Okami et al. (10) illustrated the presence of a significant difference

Table 1. Prevalence of irritable bowel syndrome among medical students from different studies based on year, sample size, and diagnostic criteria (2,3,5-18)

Authors	Country, city	Year	Analyzed sample	Target students	Prevalence	Male: Female ratio	Diagnostic tool
1. Costanian et al. (6)	Lebanon, Beirut	2015	431 medical sciences students	Medical sciences students among University students	p=20.6%	1:1.98 (M:12.6%, F:25%)	Rome III
2. Liu et al. (5)	China, Beijing	2014	767	Medical students	p=33.3%	1:1.54 (M:23.4%, F:36.1%)	Rome III
3. Basandra et al. (3)	India, New Delhi	2014	200	Medical students	p=16.5%	1:2.55 (M:8.9%, F:22.7%)	Rome III
4. Vasquez et al. (18)	Lima, Peru	2014	383	Medical students	p=12%	—	Rome III
5. Ibrahim et al. (2)	Saudi Arabia, Jeddah	2013	597	Medical students and interns	p=31.8%	1:1.914 (M:22.0%, F:41.8%)	Rome III
6. Wells et al. (11)	Canada, Western Ontario	2012	228	Medical students	20.61%	—	Rome III
7. Naeem et al. (8)	Pakistan, Karachi	2012	360	Medical students	p=28.3%	1:1.29 (M:23.8%, F:29.3%)	Rome III
8. Okami et al. (10)	Japan, Kyoto	2011	1,768	Medical and nursing students	p=35.5%	1:1.65 (M:25.2%, F:41.5%)	Rome II
9. Jung et al. (13)	South Korea, Busan	2011	319	Medical students	p=9.2%	1:1.65 (M:25.1%, F:41.3%)	Rome III
10. Shen et al. (14)	China, Wuhan	2009	491	Medical students	p=15.7%	1:0.86 (M:14.5%, F:16.8%)	Rome II
11. Dong et al. (9)	China, Shandong	2010	728	Medical students among University students	p=9.3%	—	Rome III
12. Mansour-Ghanaei et al. (7)	Iran, Rasht	2009	422	Medical students	p=12.6%	1:1.85 (M:8.1%, F:15.0%)	Rome II
13. Hori et al. (12)	Japan, Nishinomiya	2009	186	Medical students	p=22.1%	—	Rome II
14. Jafri et al. (15)	Pakistan, Karachi, Bahawalpur	2005	245	Medical students among university students	p=26.0%	1:1.65 (M:29.3%, F:24.8%)	Rome II
15. Okeke et al. (17)	Nigerian	2005	330	Medical students, Medical Laboratory Technology	p=26.1%	1:0.97 (M:26.4%, F:25.7%)	Rome II
16. Tan et al. (16)	Malaysia, Kuala Lumpur	2003	533	Medical students	p=15.8%	1:0.85 (M:18.8%, F:11.8%)	Rome I

between food products consumed by IBS medical students compared with other populations. Liu et al. (5) reported that cases of IBS reported a lower frequency of consumption of seafood.

On the other hand, the study of Jeddah revealed the absence of a statistical association between the consumption of different food items and the prevalence of IBS (2), which agrees with the study conducted among Korean medical students (13).

c) Obesity

Concerning obesity, the study of Jeddah found that morbidly obese medical students had a higher prevalence of IBS than other students (2).

➤ Physical activity

Basandra et al. (3) reported that IBS was significantly associated with inadequate practicing of physical activities

by Indian medical students. Costanian et al. (6) found that students who reported regular practicing of physical exercises had a significantly lower prevalence of IBS than others. The protective effect of physical activity was also reported from other studies of this systematic review (2,9).

➤ Sleep disorder

Liu et al. (5) reported an association between sleep disorder and IBS; participants with IBS had a significantly higher Pittsburgh Sleep Quality Index (PSQI) score than others. More than one-third of students who had IBS complained of severe sleep disorder. The study of Jeddah showed that students who slept fewer hours (<8 h/day) had a higher prevalence of IBS than others (2).

➤ Smoking

Some studies conducted among medical students revealed a significant association between cigarette smok-

ing and IBS (3). However, other studies did not show such an association (2).

➤ **Drugs and IBS**

The study of Jeddah (2) found that the prevalence of IBS was significantly higher among students who reported the regular use of medications.

➤ **Socioeconomic status**

Ibrahim et al. (2) reported the absence of statistical associations between IBS and paternal education or occupation. However, students from lower income families have a significantly higher rate of IBS than others.

➤ **Living in a dormitory**

The study of Costanian et al. (6) reported that medical students who lived in private houses or in school dormitories were approximately three times more likely to have IBS than those who lived with their families. Similar results were obtained from the study of Jeddah (2).

➤ **Higher academic grade**

Chu et al. (21) reported that students in higher grades (level) had a relatively increased prevalence of IBS than the students in lower grades, particularly among medical students. A similar finding was reported from Jeddah (2). Wells et al. (11), reported that the rate of IBS was slightly higher among Canadian students during their clerkship years than their counterpart medical students in the preclinical years.

DISCUSSION

Concerning the prevalence of IBS, the results of most of the studies of the current systematic review revealed a higher IBS prevalence among medical students (2,5,10,13,15,17) than among other university students or other populations (12). Hori et al. (12) concluded that the rate of IBS among Japanese medical students was approximately twice the prevalence of the general Japanese population. Similarly, another Chinese study reported that medical students had higher rates of functional bowel disorders (FBD) than their counterpart students from faculties of science and engineering (21). A study conducted among nursing students from Korea found that the prevalence of IBS was lower than among medical students (5.7%) (22). A recent meta-analysis of 80 different researches revealed that the prevalence of IBS differs noticeably according to the geographical area; it was 7% from South East Asia, 12% from both Northern Europe and North America, and 11.5% from eight European countries, while the highest rate was 21% from South America (23).

The cause of high prevalence of IBS among medical students may be attributed to their special learning environment (innumerable exams, profound clinical hospital practice, together

with lacking the ability of self-adjustment and adaptation) (5,24). Enormous study and exams loads, increasing future job competition, undesirable living, and eating habits make medical students to be a particularly high-risk population for IBS (2,3,5). All these factors may categorize medical students as a special group who are more prone to IBS.

Risk factors

➤ **Gender:** The results of most of the current systematic review studies revealed that female medical students had a higher prevalence of IBS than males (2,3,5,7,8,10,12,13,15). Similar results were obtained among nursing students from Korea (22) and university students from Germany (25). Similarly, studies among the general populations also reported strong associations between female gender and IBS (21,23,26-29). Results from an Iranian systematic review showed that more than one-half of the reviewed researchers found that IBS was significantly associated with female gender (26). Findings from another meta-analysis of 80 studies (30) supported that IBS was higher among females than males (OR= 1.67; 95% CI: 1.53–1.82). The higher prevalence among females may be due to the concept of “Microgenderome,” which related to the potential role of sex hormone modulation of the gut microbiota. Microgenderome is a newly emerging concept. Furthermore, sex differences in response to stress and the effect of the estrogen sex hormone on influencing the regulatory mechanisms of the brain-gut axis may be other causes of higher IBS prevalence among females (31).

➤ **Psychological and psychiatric factors (stress, anxiety, and depression)**

The associations between IBS and the higher levels of psychiatric distress and maladaptive coping strategies were reported (2,3,5,8,10,16) and also supported by many studies from the current systematic review. Lee et al. (32) reported that stress (OR=1.730; 95% CI: 1.539–1.945) and depression (OR=3.508; 95% CI: 3.005–4.096) were among the risk factors of IBS. The rates of IBS increased along with increasing stress levels. A Turkish case-control study (33) showed that depression among IBS cases was significantly much higher (38%) than among the controls (4%). Another recent study from Belgium reported an increased risk of patients with psychological co-morbidity to develop post-infectious IBS (PI-IBS) (34). Medical students represent a unique stress-heavy lifestyle model, consisting of long hours of focused physical and cognitive activity under significant social-competitive pressure (3,24).

➤ **Infection**

The current systematic review illustrated some role of infection in IBS (2). Similarly, the results of a meta-analysis between the Chinese community illustrated that the history of intestinal infection may increase the risk for IBS more

than two times (OR=2.39; 95% CI: 1.69–3.38) (35). Schwille-Kiuntke et al. (36) conducted another meta-analysis on PI-IBS after travelers' diarrhea and found the presence of a strong association between travelers' diarrhea and PI-IBS. The pooled relative risk (RR) was 3.35 (95% CI: 2.22–5.05). Currently, it is postulated that the intestinal microbiota forms a complex ecosystem that is in close contact with its host and has an important impact on health. An increasing number of disorders are associated with disturbances in this ecosystem (37).

➤ **Familial factors**

Evidence suggests a familial role of IBS among the general population (38,39) correlates with a study conducted among medical students (2). A family-based case-control study in the USA confirmed the familial clustering of IBS cases and reported that IBS family history is a recognized predictor of it (38). Similarly, another familial aggregation of IBS cases was observed in other Western countries (39). It was found that there is an increased IBS risk among the first, second, and third-degree relatives from a Swedish population. Genetic factors may also contribute to the patho-physiology, which indicates a genetic component of the familial clustering of IBS (40). These studies correlate with results obtained among medical students.

➤ **Diet**

Diet is known to play a significant role in the IBS patho-physiology as food allergy/hypersensitivity, poorly absorbed carbohydrates and fiber, and obesity co-morbidity (41).

a) Allergy and food hypersensitivity

The study of Jeddah (2) found that IBS was significantly higher among medical students who had food hypersensitivity (64.0%) than among those who did not have food hypersensitivity (30.4%). Similarly, Zhang et al. (35) conducted a meta-analysis of the studies among the Chinese general population and reported that food allergy increased the liability of IBS (OR=2.80, 95% CI: 2.12–3.67). The Turkish case-control study reported that the skin prick test and the mean IgE positivity levels were significantly more among IBS cases than among their controls (33).

b) Dietary constituents

The results of some studies from the current systematic review among medical students revealed associations between certain food intake and IBS (3), (10). Furthermore, a recent study in 2015 among the Japanese general population reported that consumption of staple foods, such as rice, bread, pasta, and buckwheat noodles, is associated with a higher prevalence of IBS with a dose-response relationship (42). Food is a recognized trigger for most of the IBS cases (43), and a new paradigm shift highlights the relationship between diet

and IBS patho-physiology, such as effects on intestinal microbiota, inflammation, motility, permeability, and visceral hypersensitivity.

c) Obesity

Among the general population, Aro et al. (44) reported the presence of an association between obesity and IBS (OR=1.58; 95% CI: 1.05–2.38). This results correlate with the results among medical students from Jeddah (2).

➤ **Physical activity**

A randomized controlled trial was conducted among the general population by randomly allocated IBS patients to either the intervention group performing physical activity or a control group. The results showed that the physical activity group had fewer IBS symptoms than the control group (45). Similarly, some studies of the systematic review showed a protective effect of activity (2,3).

➤ **Sleep disorder**

IBS patients were generally reported to have poor sleep (40). It was postulated that poor sleep is a dangerous stress factor which can seriously influence gastrointestinal function, cognition, emotion, and somatic reaction. Furthermore, disruption of normal biological rhythm may lead to a change in visceral motility and sensitivity, thereby altering the colonic physiological function of the gut (5). This agrees with the results of some studies conducted among medical students (3,5).

➤ **Smoking**

The study of Jeddah (3) revealed the presence of a significant association between cigarette smoking and IBS among medical students. Similarly, some studies conducted among the general population (46,47) found that smoking was positively associated with IBS, which may be attributed to the direct effect of nicotine or more likely due to smoking as a marker for unpleasant psychological factors.

➤ **Drug**

Gastroenterologists often reported that IBS sufferers generally provide a history of utilization of drugs that can alter the intestinal homeostasis, such as non-steroidal anti-inflammatory drugs (NSAIDs) and proton pump inhibitors (PPIs) (48). This systematic review showed that IBS was significantly higher among medical students who reported a regular use of medications from Jeddah (3).

➤ **Socioeconomic status**

One study of the current systematic review showed a relationship between the socioeconomic condition and IBS (2). Similarly, it was found from a study conducted among the general population that there are associations be-

tween the low socioeconomic condition, bad hygienic condition, and IBS (49). However, another study did not find a significant association between the economic status and IBS prevalence (50).

Strength of evidence

The current systematic review may be the first systematic review conducted on IBS and risk factors among medical students. The prevalence of IBS was generally higher than students from other faculties in most of the studies, which requires further attention. Many risk factors were identified among medical students which increase their susceptibility to stresses of exams, work load, etc.

Limitations

Some studies that were conducted among medical students were not published, and other studies were published in other languages in the Chinese language. Furthermore, some studies conducted among medical students were based on convenience samples. In addition, our systematic review did not strictly compare the rates and findings of the studies among medical students with gender- and age-matched subjects because of some lack of such studies. There is another limitation from using studies conducted among the general population in the discussion.

In conclusion, IBS is a prevalent disorder among medical students, and the prevalence was noticed to be higher than among the general population. There are many risk factors of IBS, including female gender, stress, infection, and drugs. In addition, IBS may have a marked impact on medical students' study habits, ability to concentrate, attendance of classes, and performance in tests.

It is recommended from this systematic review conducted among medical students that providing campus-wide health lectures is important. It would include symptoms and management of common stress-related psychological, physical, and gastrointestinal disorders. Incorporation of lifestyle modifications based on dietary habits and physical activity holds a key in the management of these disorders.

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REFERENCES

- Gholamrezaei A, Zolfaghari B, Farajzadegan Z, et al. Linguistic validation of the Irritable Bowel Syndrome-Quality of Life Questionnaire for Iranian patients. *Acta Med Iran* 2011; 49: 390-5.
- Ibrahim NK, Battarjee WF, Almeahmadi SA. Prevalence and predictors of irritable bowel syndrome among medical students and interns in King Abdulaziz University, Jeddah. *Libyan J Med* 2013; 8: 21287.
- Basandra S, Bajaj D. Epidemiology of Dyspepsia and Irritable Bowel Syndrome (IBS) in Medical Students of Northern India. *J Clin Diagn Res* 2014; 8: JC13-6.
- Canavan C, West J, Card T. The epidemiology of irritable bowel syndrome. *Clin Epidemiol* 2014; 6: 71-80.
- Liu Y, Liu L, Yang Y, et al. 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. [\[CrossRef\]](#)
- Costanian C, Tamim H, Assaad S. Prevalence and factors associated with irritable bowel syndrome among university students in Lebanon: Findings from a cross-sectional study. *World J Gastroenterol* 2015; 21: 3628-35. [\[CrossRef\]](#)
- Mansour-Ghanaei F, Fallah MS, Heidarzadeh A, Jafarshad R, Joukar F, Ghasemipour R, et al. Prevalence and characteristics of irritable bowel syndrome (IBS) amongst medical students of Gilan Northern Province of Iran. *Middle East Journal of Digestive Diseases (MEJDD)*. 2011;1(2):100-5.
- Naeem SS, Siddiqui EU, Kazi AN, Memon AA, Khan ST, Ahmed B. Prevalence and factors associated with irritable bowel syndrome among medical students of Karachi, Pakistan: a cross-sectional study. *BMC Res Notes* 2012; 5: 255. [\[CrossRef\]](#)
- Dong YY, Zuo XL, Li CQ, Yu YB, Zhao QJ, Li YQ. Prevalence of irritable bowel syndrome in Chinese college and university students assessed using Rome III criteria. *World J Gastroenterol* 2010; 16: 4221-6. [\[CrossRef\]](#)
- Okami Y, Kato T, Nin G, et al. Lifestyle and psychological factors related to irritable bowel syndrome in nursing and medical school students. *J Gastroenterol* 2011; 46: 1403-10. [\[CrossRef\]](#)
- 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.
- Hori K, Matsumoto T, Miwa H. Analysis of the gastrointestinal symptoms of uninvestigated dyspepsia and irritable bowel syndrome. *Gut Liver* 2009; 3: 192-6. [\[CrossRef\]](#)
- Jung HJ, Park MI, Moon W, et al. Are Food Constituents Relevant to the Irritable Bowel Syndrome in Young Adults? - A Rome III Based Prevalence Study of the Korean Medical Students. *J Neurogastroenterol Motil* 2011; 17: 294-9. [\[CrossRef\]](#)
- Shen L, Kong H, Hou X. Prevalence of irritable bowel syndrome and its relationship with psychological stress status in Chinese university students. *J Gastroenterol Hepatol* 2009; 24: 1885-90. [\[CrossRef\]](#)
- Jafri W, Yakoob J, Jafri N, Islam M, Ali QM. Frequency of irritable bowel syndrome in college students. *J Ayub Med Coll Abbotabad* 2005; 17: 9-11.
- Tan YM, Goh KL, Muhidayah R, Ooi CL, Salem O. Prevalence of irritable bowel syndrome in young adult Malaysians: a survey among medical students. *J Gastroenterol Hepatol* 2003; 18: 1412-6. [\[CrossRef\]](#)
- Okeke EN, Agaba EI, Gwamzhi L, Achinge GI, Angbazo D, Malu AO. Prevalence of irritable bowel syndrome in a Nigerian student population. *Afr J Med Med Sci* 2005; 34: 33-6.

18. Vasquez G, Pezua A, Huapaya J, Marcos L, Guha S, Machicado J, editors. Prevalence of Irritable Bowel Syndrome Among Medical Students of a Medical School in Lima, Peru 2014: Nature Publishing Group 75 Varick St, NEW YORK, USA.
19. Ford AC, Talley NJ. Irritable bowel syndrome. *BMJ* 2012; 345: e5836. [\[CrossRef\]](#)
20. Canavan C, West J, Card T. Review article: the economic impact of the irritable bowel syndrome. *Aliment Pharmacol Ther* 2014; 40: 1023-34. [\[CrossRef\]](#)
21. Chu L, Zhou H, Lü B, Li M, Chen MY. [An epidemiological study of functional bowel disorders in Zhejiang college students and its relationship with psychological factors]. *Zhonghua Nei Ke Za Zhi* 2012; 51: 429-32.
22. Kim YJ, Ban DJ. Prevalence of irritable bowel syndrome, influence of lifestyle factors and bowel habits in Korean college students. *Int J Nurs Stud* 2005; 42: 247-54. [\[CrossRef\]](#)
23. Hungin AP, Whorwell PJ, Tack J, Mearin F. The prevalence, patterns and impact of irritable bowel syndrome: an international survey of 40,000 subjects. *Aliment Pharmacol Ther* 2003; 17: 643-50. [\[CrossRef\]](#)
24. Ibrahim N, Al-Kharboush D, El-Khatib L, Al-Habib A, Asali D. Prevalence and Predictors of Anxiety and Depression among Female Medical Students in King Abdulaziz University, Jeddah, Saudi Arabia. *Iran J Public Health* 2013; 42: 726-36.
25. Gulewitsch MD, Enck P, Hautzinger M, Schlarb AA. Irritable bowel syndrome symptoms among German students: prevalence, characteristics, and associations to somatic complaints, sleep, quality of life, and childhood abdominal pain. *Eur J Gastroenterol Hepatol* 2011; 23: 311-6. [\[CrossRef\]](#)
26. Jahangiri P, Jazi MS, Keshteli AH, Sadeghpour S, Amini E, Adibi P. Irritable Bowel Syndrome in Iran: SEPAHAN Systematic Review No. 1. *Int J Prev Med* 2012; 3(Suppl 1): 1-9.
27. Abdulmajeed A, Rabab MA, Sliem HA, Hebatallah NE. Pattern of irritable bowel syndrome and its impact on quality of life in primary health care center attendees, Suez governorate, Egypt. *Pan Afr Med J* 2011; 9: 5.
28. Alhazmi AH. Irritable bowel syndrome in secondary school male students in AlJouf Province, north of Saudi Arabia. *J Pak Med Assoc* 2011; 61: 1111-5.
29. Song SW, Park SJ, Kim SH, Kang SG. Relationship between irritable bowel syndrome, worry and stress in adolescent girls. *J Korean Med Sci* 2012; 27: 1398-404. [\[CrossRef\]](#)
30. 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. [\[CrossRef\]](#)
31. Mulak A, Tache Y, Larauche M. Sex hormones in the modulation of irritable bowel syndrome. *World J Gastroenterol* 2014; 20: 2433-48. [\[CrossRef\]](#)
32. Lee SP, Sung IK, Kim JH, Lee SY, Park HS, Shim CS. The effect of emotional stress and depression on the prevalence of digestive diseases. *J Neurogastroenterol Motil* 2015; 21: 273-82. [\[CrossRef\]](#)
33. Uz E, Turkay C, Aytac S, Bavbek N. Risk factors for irritable bowel syndrome in Turkish population: role of food allergy. *J Clin Gastroenterol* 2007; 41: 380-3. [\[CrossRef\]](#)
34. Wouters MM, Van Wanrooy S, Nguyen A, et al. Psychological comorbidity increases the risk for postinfectious IBS partly by enhanced susceptibility to develop infectious gastroenteritis. *Gut* 2015; pii: gutjnl-2015-309460.
35. Zhang L, Duan L, Liu Y, et al. [A meta-analysis of the prevalence and risk factors of irritable bowel syndrome in Chinese community]. *Zhonghua Nei Ke Za Zhi* 2014; 53: 969-75.
36. Schwiller-Kiuntke J, Mazurak N, Enck P. Systematic review with meta-analysis: post-infectious irritable bowel syndrome after travellers' diarrhoea. *Aliment Pharmacol Ther* 2015; 41: 1029-37. [\[CrossRef\]](#)
37. König J, Brummer RJ. Alteration of the intestinal microbiota as a cause of and a potential therapeutic option in irritable bowel syndrome. *Benef Microbes* 2014; 5: 247-61. [\[CrossRef\]](#)
38. Saito YA, Petersen GM, Larson JJ, et al. Familial aggregation of irritable bowel syndrome: a family case-control study. *Am J Gastroenterol* 2010; 105: 833-41. [\[CrossRef\]](#)
39. Heitkemper MM, Kohen R, Jun SE, Jarrett ME. Genetics and gastrointestinal symptoms. *Annu Rev Nurs Res* 2011; 29: 261-80. [\[CrossRef\]](#)
40. Heitkemper M, Jarrett M, Jun SE. Update on irritable bowel syndrome program of research. *J Korean Acad Nurs* 2013; 43: 579-86. [\[CrossRef\]](#)
41. El-Salhy M, Gundersen D. Diet in irritable bowel syndrome. *Nutr J* 2015; 14: 36. [\[CrossRef\]](#)
42. Zheng Z, Huang C, Guo Y, et al. Staple foods consumption and irritable bowel syndrome in Japanese adults: a cross-sectional study. *PLoS One* 2015; 10: e0119097. [\[CrossRef\]](#)
43. Barrett JS, Gibson PR. Fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPs) and nonallergic food intolerance: FODMAPs or food chemicals? *Therap Adv Gastroenterol* 2012; 5: 261-8. [\[CrossRef\]](#)
44. Aro P, Ronkainen J, Talley NJ, Storskrubb T, Bolling-Sternevald E, Agreus L. Body mass index and chronic unexplained gastrointestinal symptoms: an adult endoscopic population based study. *Gut* 2005; 54: 1377-83. [\[CrossRef\]](#)
45. Johannesson E, Simren M, Strid H, Bajor A, Sadik R. Physical activity improves symptoms in irritable bowel syndrome: a randomized controlled trial. *Am J Gastroenterol* 2011; 106: 915-22. [\[CrossRef\]](#)
46. Farzaneh N, Ghobaklou M, Moghimi-Dehkordi B, Naderi N, Fadaei F. Effects of demographic factors, body mass index, alcohol drinking and smoking habits on irritable bowel syndrome: a case control study. *Ann Med Health Sci Res* 2013; 3: 391-6. [\[CrossRef\]](#)
47. Hauser W, Layer P, Henningsen P, Kruis W. Functional bowel disorders in adults. *Dtsch Arztebl Int* 2012; 109: 83-94.
48. Keszthelyi D, Dackus GH, Masclee GM, Kruijmel JW, Masclee AA. Increased proton pump inhibitor and NSAID exposure in irritable bowel syndrome: results from a case-control study. *BMC Gastroenterol* 2012; 12: 121. [\[CrossRef\]](#)
49. Bytzer P, Howell S, Leemon M, Young LJ, Jones MP, Talley NJ. Low socioeconomic class is a risk factor for upper and lower gastrointestinal symptoms: a population based study in 15 000 Australian adults. *Gut* 2001; 49: 66-72. [\[CrossRef\]](#)
50. Zhu X, Chen W, Shen Y. A cross-sectional study of risk factors for irritable bowel syndrome in children 8-13 years of age in Suzhou, China. *Gastroenterol Res Pract* 2014; 2014: 198461. [\[CrossRef\]](#)