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## The Impact and Prevalence of Food Allergies among Adults with Irritable Bowel Syndrome

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### Abstract

**Background:** Abdominal pain that flares up again and irregular intestinal motility are the features of irritable bowel syndrome (IBS), a complex bowel symptom with an incidence of 5.2-22% in people. IBS and allergy illnesses share many common causes, including food intolerance, post-infectious inflammation, and allergic reactions. This suggests that there may be an immune-mediated relationship between the two conditions. The Research Ethics Committee (REC) at the Faculty of Medicine, Ain Shams University, approved this research to evaluate the impact and incidence of food allergies among adults with IBS.

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**Methods:** Between January 2023 and June 2023, we conducted our prospective cohort study in the gastroenterology unit of Ain Shams University Hospital, using Rome IV criteria to diagnose IBS in 84 participants after exclusion of cases with immune deficiencies, significant previous abdominal surgery, and organic gastrointestinal disorders. Participants' dietary habits and demographic information were noted, and they also underwent an entire medical history, physical examination, CBC, stool analyses, serum IgE tests, and a two-week food record to monitor their intake of allergenic foods and their impact on the IBS manifestations.

**Results:** Among our research subjects, the prevalence of food allergies was in 50% of patients, with common sensitivities to cow's milk, egg white, and wheat. Significant associations existed between food allergies and IBS subtypes, particularly IBS-C.

**In Conclusion,** food allergies are common in IBS cases, and there is a strong correlation between specific food allergies and IBS subtypes, especially in people who meet specific clinical and demographic criteria.

**Keywords:** *Food Allergy, allergens, Irritable Bowel Syndrome, Abdominal pain, IBS subtypes, Constipation, Diarrhea, Rome IV Criteria, Serum IgE, Functional gastrointestinal disorders.*

## **Introduction**

With no apparent organic etiology, IBS is an intestinal disorder defined as abdominal pain and abnormal bowel habits. Even though no consistent structural or motility issues have been found, experts advise following the guidelines for diagnosis [1].

Rome IV described IBS as a functional intestinal condition with repeated episodes of colic associated with altered bowel habits. At least 6 months should pass before establishing the diagnosis, and symptoms should have been reported during the last 3 months [2].

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Four different IBS subtypes are identified based on stool form using the Bristol Stool Form Scale (BSFS): More than 25% of the stools are BSS 1 or 2, and less than 25% are BSS 6 or 7 in people with IBS with a predominant constipation (IBS-C). The condition is diarrhea-predominant IBS (IBS-D) if > 25% of the stool forms are BSS 6 or 7 and < 25% are BSS 1 or 2. Less than 25% of stools in people with unclassified IBS (IBS-U) are abnormal, although they meet other IBS criteria. IBS mixed type (IBS-M) is characterized by 25% constipation and 25% diarrhea [3].

Visceral hyperalgesia, abnormal GI motility, and psychopathology are the three components of the traditional ideas of the pathogenesis of IBS [4].

Food is a significant factor in IBS: over 60% of patients claim that they complain after food intake. Eighty-four percent of IBS patients contended that at least one dietary item caused their symptoms during a meal [5].

The absence of specific dietary training and scientific data can explain the distrust of most gastroenterologists and general care physicians. It is far more challenging to identify the food groups or particular substances that initiate or exacerbate symptoms of IBS. Dietary restrictions for functional gastrointestinal disorders (FGIDs) are scarce and primarily dependent on pathophysiology knowledge or empiricism rather than consensus guidelines or randomized clinical trials [6].

An aberrant reaction to a food brought on by an immunoglobulin E (IgE) antibody is known as a food allergy [7]. The breakdown of immunologic and clinical tolerance to digested food is the standard mechanism underlying a variety of food allergies. Food allergy sensitization may occur via the skin, GIT, or, more seldom, the respiratory system; what is probably related to impaired or inflamed barrier function? [8]

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Our research aims to assess the impact and incidence of food allergies among adults with IBS.

## Patients and Methods

Eighty-four Egyptian participants were recruited in our prospective cohort study. The IBS diagnosis was established based on the Rome IV criteria for functional intestinal disorders. For a minimum of one day every week on average for the previous three months, the patients who were included experienced recurrent abdominal pain that met two or more of the subsequent criteria: (1) improve with passing stool; (2) onset linked to altered stool frequency; or (3) onset linked to altered stool appearance[9].

By assuming that 50% of cases with IBS have food allergies and using Power Analysis and Sample Size Software (PASS 15) (Version 15.0.10) to calculate the sample size, a sample size of at least 84 patients with IBS will be sufficient to meet the study's objective. The sample size was calculated with a margin of error of +0.10 and a confidence level of 90%.

The cases considered were taken from the inpatient internal medicine department or the gastrointestinal clinic at Ain Shams University Hospital between January and June 2023, regardless of their socioeconomic class, cultural background, or level of education.

The scientific ethics committee cleared this study for publication, and each case provided informed consent.

Patients with immunological deficiencies, patients with significant previous abdominal surgery, and patients with organic gastrointestinal disorders were excluded from the research.

Every participant underwent a thorough medical history, including demographic data, the patient's dietary intake, symptoms, family history, chronic illness (HTN, DM, heart failure, stroke, and CKD), and smoking. We also performed a complete physical assessment. We

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investigated all patients using a complete blood count, stool analysis, serum total IgE, and food allergen-specific IgE.

An IBS Symptoms Questionnaire was used for each participant to assess the condition. A validated questionnaire scoring method, which included an IBS symptom severity score, was used to evaluate the symptoms. Every inquiry featured a standard response scale, and the symptoms were all rated on a 4-point Likert scale that went from 0 to never. One denotes infrequently, two frequently, and three always. The raw score range is 0 to 33 [10], [11].

We applied a factor to the score to improve comprehension and display, causing it to span from 0 to 500. The multiplying factor was mathematically determined by dividing the 500 new maximums by the actual maximum [12].

We evaluated the subsequent food allergens: fish, egg, cow's milk, soy, peanut, wheat, and tomato. Patients were assessed using a questionnaire to determine whether a food allergy was positive or negative. They also had to keep a food record for two weeks, during which they had to eat wheat, eggs, tomatoes, cow's milk, and its derivatives. Additionally, patients who self-reported having food allergies were advised to avoid eating or encountering the offending food. The patients recorded their food intake, and the degree to which they followed the elimination diet was assessed. Furthermore, we evaluate the impact of IBS by documenting the symptoms and changes in bowel habits that occur after consuming these foods.

- **Statistical analysis**

All the data was assessed, coded, and investigated using the SPSS statistical program (USA, Chicago, IBM Inc., IL) for the analysis. For quantitative (numerical) variables, the data was expressed as mean  $\pm$  SD, and for qualitative (categorical) variables, frequency and percentage. The Chi-square test and Cramer's V test were used for the associations' assessment. Post-hoc analyses were used to compare food allergies across IBS subtypes. A significant value was defined statistically as a two-tailed P value of less than 0.05.

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## Results

Eighty-four subjects were included in our study. The mean age was  $35.6 \pm 4.0$  years old, ranging from 29 to 43 years old. Most participants were female, accounting for 70.2% of the sample, while 29.8% were male. Regarding residence, a more significant proportion of the patients were urban residents (61.9%) compared to those in rural areas (38.1%). Also, health-related factors show that 25% of the cases had a family history of IBS, while smoking was reported by 6% of the patients. Hypertension was present in 9.5% of the patients, and both diabetes mellitus and stroke were observed in 6% and 2.4% of the patients, respectively. Heart failure and chronic kidney disease were relatively rare, affecting 2.4% and 1.2% of the patients, respectively. Abdominal pain was a common symptom, with 40.5% of patients experiencing mild pain and 59.5% reporting moderate pain.

The distribution of IBS subtypes in our study was as follows: 26.2% had IBS-C, 60.7% had IBS-D, and 13.1% had IBS-M **Fig [1]**.

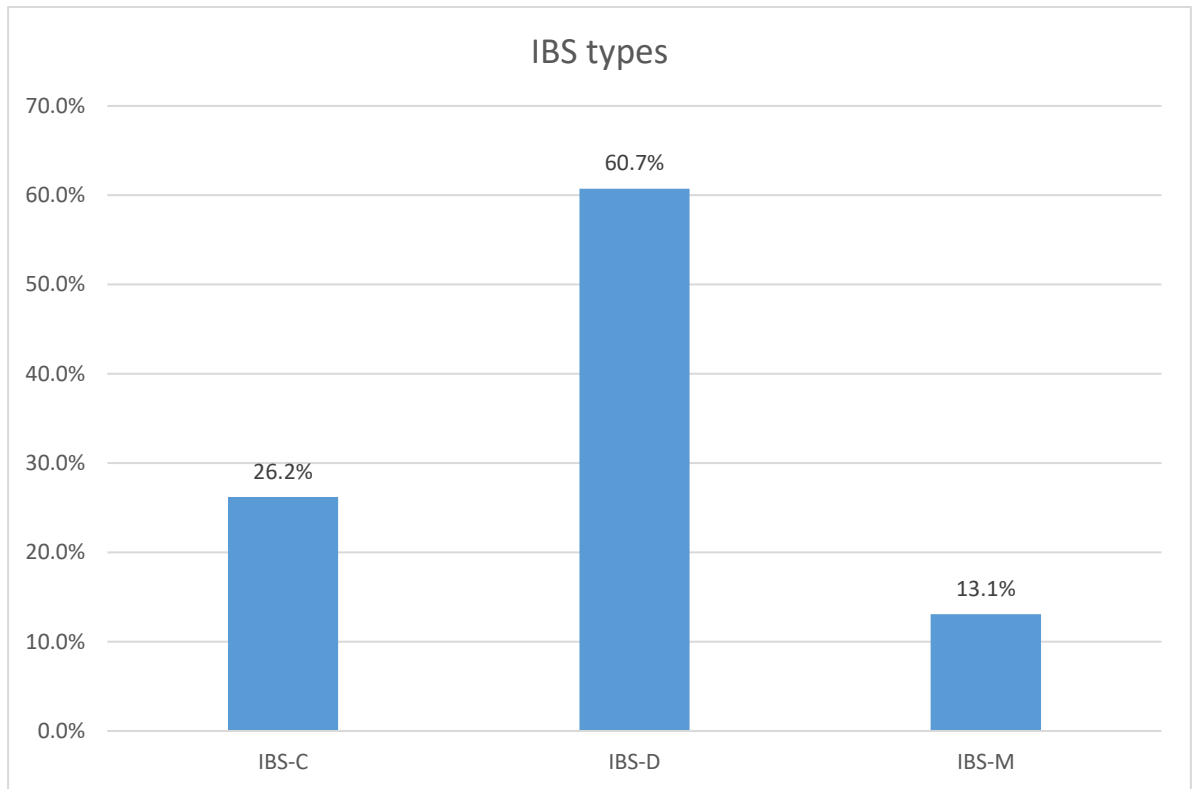


Fig1. The distribution of irritable bowel syndrome (IBS) subtypes among the study cases.

Half of the cases reported having a food allergy, and 19% had elevated serum total IgE levels, often associated with allergic responses. When testing for specific IgE antibodies, 50% of patients were sensitive to cow's milk, 39.3% to egg white, and 33.3% to wheat. Additionally, 23.8% of patients had IgE antibodies for soy, peanuts, tomatoes, and fish. **Fig [2]**

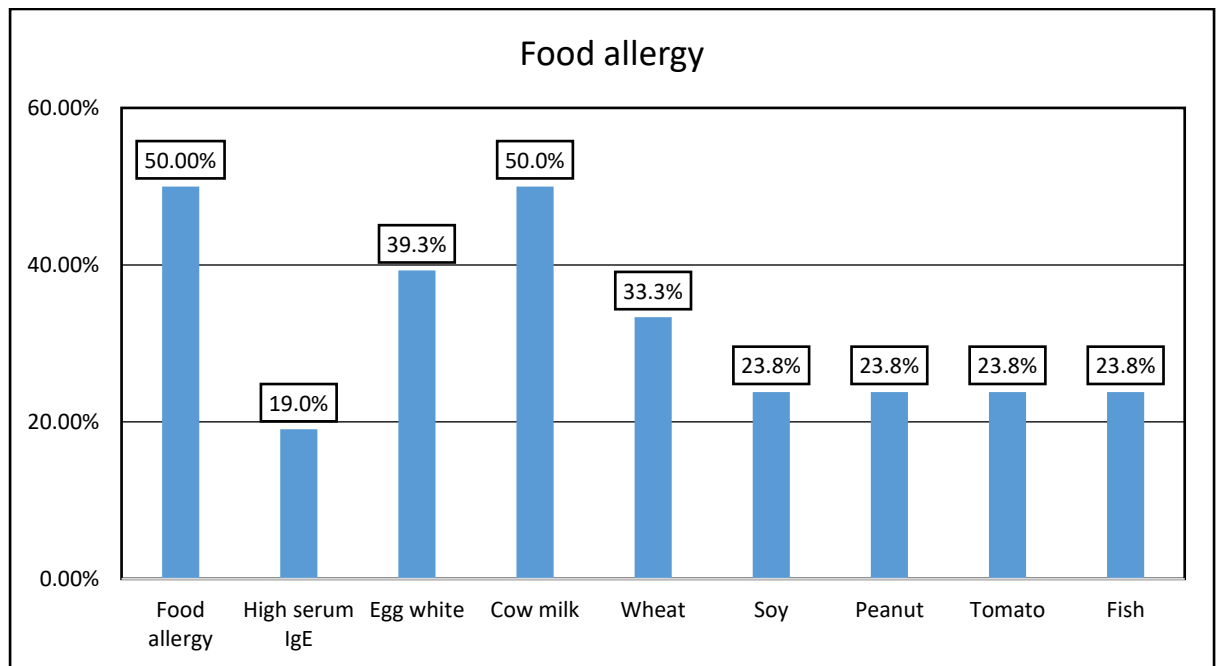


Fig2. The distribution of food allergy among the study cases.

The relationship between food allergies and IBS subtypes revealed that egg white and cow milk allergies were absent in IBS-D but present in all IBS-C and IBS-M cases ( $p < 0.001$ ). Wheat allergy was also lacking in IBS-D, found in 77.3% of IBS-C and all IBS-M cases ( $p < 0.001$ ). Soy, peanut, tomato, and fish allergies followed the same pattern, with no instances in IBS-D and significant occurrences in IBS-C and IBS-M ( $p < 0.001$ ). Post-hoc analyses revealed that IBS-D versus IBS-C and IBS-D versus IBS-M showed substantial differences in all food allergies ( $p < 0.001$ ). For IBS-C versus IBS-M, egg white and cow milk had no comparison as all patients were allergic. Wheat allergy differences were insignificant ( $p = 0.111$ ); however, significant differences existed for soy, peanut, tomato, and fish allergies ( $p = 0.001$ ) **Tab [1]**.

Tab 1. Association between different food allergy and IBS subtypes.

Type of food allergy	IBS			P-value <sup>#</sup>
	IBS-D	IBS-C	IBS-M	
Egg white	0(0%)	22(100%)	11(100%)	<0.001*



<b>Cow milk</b>	9(21.4%)	22(100%)	11(100%)	<b>&lt;0.001*</b>
<b>Wheat</b>	0(0%)	17(77.3%)	11(100%)	<b>&lt;0.001*</b>
<b>Soy</b>	0(0%)	9(40.9%)	11(100%)	<b>&lt;0.001*</b>
<b>Peanut</b>	0(0%)	9(40.9%)	11(100%)	<b>&lt;0.001*</b>
<b>Tomato</b>	0(0%)	9(40.9%)	11(100%)	<b>&lt;0.001*</b>
<b>Fish</b>	0(0%)	9(40.9%)	11(100%)	<b>&lt;0.001*</b>

<b>Post-hoc analyses</b>			
	IBS-D versus IBS-C	IBS-D versus IBS-M	IBS-C-versus IBS-M
Egg white	<0.001*	<0.001*	NA
Cow milk	<0.001*	<0.001*	NA
Wheat	<0.001*	<0.001*	0.111
Soy	<0.001*	<0.001*	0.001*
Peanut	<0.001*	<0.001*	0.001*
Tomato	<0.001*	<0.001*	0.001*
Fish	<0.001*	<0.001*	0.001*

# Chi square test used. \*Statistically significant as  $p < 0.05$ .

The relationship between food allergies and risk factors revealed that strong associations existed. Males made up 59.5% of those with food allergies, and 50% had a positive family history. Smoking was moderately associated, with 11.9% of the allergy group being smokers **Tab [2]**

Tab2. Association between Food allergy and risk factors.

		Food allergy		No food allergy		Test of association		
		42		42		p-value	Strength of association	
Sex	Male	25	59.5%	0	0.0%	$p < 0.001$	Cramer's V	0.65
	Female	17	40.5%	42	100.0%			
Family history	Positive	21	50.0%	0	0.0%	$p < 0.001$	Cramer's V	0.58
Smoking	Positive	5	11.9%	0	0.0%	0.028	Cramer's V	0.25

The association between food allergies and IgE levels emphasized that for egg whites, 48.5% of positive cases had high IgE, with no high IgE in negative cases. Cow milk allergy had 38.1% of positive cases with high IgE. Wheat allergy showed a more vital link, with 57.1%

of positive cases having high IgE. Soy, peanut, tomato, and fish allergies had 80% of positive cases with high IgE, showing powerful associations **Tab [3]**.

Tab 3. Association between IgE level and different food allergies.

Type of food allergy	number of cases	Ig E results				Test of association	
		High Ig E		Normal Ig E		p-value	Strength of association
Egg white							
positive	33	16	48.5%	17	51.5%	p < 0.001	0.6
negative	51	0	0.0%	51	100.0%		
Cow milk							
positive	42	16	38.1%	26	61.9%	p < 0.001	0.49
negative	42	0	0.0%	42	100.0%		
Wheat							
positive	28	16	57.1%	12	42.9%	p < 0.001	0.69
negative	56	0	0.0%	56	100.0%		
Soy							
positive	20	16	80.0%	4	20.0%	p < 0.001	0.8
negative	64	0	0.0%	64	100.0%		
Peanut							
positive	20	16	80.0%	4	20.0%	p < 0.001	0.8
negative	64	0	0.0%	64	100.0%		
Tomato							
positive	20	16	80.0%	4	20.0%	p < 0.001	0.8
negative	64	0	0.0%	64	100.0%		
Fish							
positive	20	16	80.0%	4	20.0%	p < 0.001	0.8
negative	64	0	0.0%	64	100.0%		

% are of rows: 48.5% of cases with positive egg white allergy have high Ig E. The Chi-square test was used. \*Statistically significant as p<0.05. Strength of association is provided using Cramer's V.

### Discussion:

The prevalence of IBS is high in individuals with allergic disorders, indicating a potential connection between the two. Adverse food reactions, such as intolerances and allergies, often worsen gastrointestinal symptoms in IBS patients [13].

Our research aimed to investigate how IBS affects patients' lives and how often they experience food allergies.

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This study found that 40.5% of IBS patients with food allergies were female, and 59.5% of patients were male. Conversely, all IBS patients who did not have a food allergy were female, with a strong correlation between the sexes in terms of food allergy.

Research on food allergies that dates back to the early 1980s has noted a gender bias. According to these and other studies conducted in the 1990s and 2000s, the sex ratio of adult females with food allergies was 6:4 to that of males. More recently, a 2009 literature review stated a 1.8 to 1 ratio in the incidence of IgE-mediated food allergies among those younger than 18 between males and girls, respectively [14].

A thorough search of the PubMed literature for IgE-mediated allergy to 11 allergenic foods of international regulatory interest was conducted by Kelly and Caleb. There was no date constraint, and only English-language items were considered. 591 of the 4744 articles that were retrieved fulfilled the inclusion criteria, signifying 17528 individuals who had dietary allergies. In contrast to the male/female ratio of 1.80 for children with food allergies, which was 64.35% for males and 35.65% for females, the adult one (male/female ratio, 0.53), with 34.82% for males and 65.18% for females [15].

According to this study, 50% of IBS patients with food allergies had a positive family history. In contrast, none of the IBS patients without food allergies had a family history that could explain how a food allergy and family history are related to the development of IBS. These findings need further investigation so that no more studies discuss the relationship between family history with IBS and food allergies.

According to research conducted in February 2020 on 400 students from Najran, KSA, males with a positive family history of IBS had a significantly greater incidence of the condition. In line with earlier studies, the significant association between a positive family history and the higher prevalence of IBS suggests that having both an IBS-afflicted mother and

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a father is a significant independent predictor of IBS. Evidence suggests that the underlying cause of IBS may be a hereditary etiology or a shared home environmental exposure [16].

This study showed that 60.7% had IBS-D, 26.2% had IBS-C, and 13.1% had IBS-M. Also, 40.5% of cases had mild abdominal pain, while 59.5% had moderate abdominal pain.

Against our findings, Hassanin et al. conducted a study in 2021 that showed that among the IBS patients they evaluated, the IBS-D subtype was more common than the IBS-C subtype: 62.5% of patients had IBS-D, while 20 patients (or 25%) had IBS-C [17]. Also, an Australian study found that the IBS-D subtype was more significant than the IBS-C subtype, contrary to our findings [18].

Elhosseiny et al. conducted a study to estimate the incidence of IBS and identify risk factors. IBS was found in 31.7% of subjects, with greater incidence in women and those with a family history of IBS. According to the study, of the groups under investigation, 26.6% had IBS-D, 73.4% had IBS-C, and none had the IBS-M variety [19].

According to this study, serum IgE levels were elevated in 19% of cases, and food allergies accounted for 50%. Also, 39.3% of the patients had an allergy to egg white, 50% to cow milk, 33.3% to wheat, 23.8% to soy, 23.8% to peanut, 23.8% to tomato, and 23.8% to fish.

According to Katsumata et al., little research hasn't been done on the connection between IBS and serological food hypersensitivity. There is no evidence to show that IBS subjects have a substantially higher incidence of serological food hypersensitivity than healthy controls, despite studies finding a higher frequency of IBS in people who self-report food hypersensitivity. Studies have revealed comparable food tolerance rates in healthy people and IBS sufferers [20].

In their study, Akkus et al. evaluated the prevalence of food hypersensitivity and allergic disorders. Of the 69 patients, the IBS-C group comprised 56.52%, the IBS-D group

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27.54%, the IBS-M group 13.04%, and the IBS-U group 2.90%. Among the IBS subgroups, there were no appreciable variations in the prevalence of allergic illness or food allergies ( $p = 0.519$  and  $p = 0.849$ , respectively). Of those with IBS-C, IBS-D, IBS-M, and IBS-U, food allergies were recorded in 46.15%, 57.89%, 44.44%, and 50.00% of cases, respectively. There were no statistically significant differences ( $p = 0.348$ ) between the 19.45% of IBS-C patients, 36.84% of IBS-D patients, and 33.33% of IBS-M patients with elevated serum IgE levels. The study found no evidence of a significant correlation between the different IBS subtypes and blood IgE levels [21].

The associations between IBS subtypes and food allergies highlight how complicated this disorder is. Since many IBS patients are hypersensitive to a wide range of foods, it is critical to take into account each patient's unique allergic response when treating IBS symptoms. [22]

The results of our study investigated the association between various food allergies and IBS subtypes and highlighted significant patterns. Egg white allergy was reported in all patients with IBS-C and IBS-M. In contrast, none of the patients with IBS-D had this allergy, indicating a strong association with the constipation-predominant and mixed-type IBS subtypes ( $p < 0.001$ ). Similarly, cow's milk allergy was observed in 100% of patients with IBS-C and IBS-M and 21.4% of those with IBS-D, suggesting a broader prevalence of this allergy among IBS subtypes but still with a vital significance ( $p < 0.001$ ). Wheat allergy followed a similar trend, being present in 77.3% of IBS-C patients and all IBS-M patients but not observed in any IBS-D cases ( $p < 0.001$ ). The data further showed that soy, peanut, tomato, and fish allergies were highly prevalent in IBS-M patients, with 100% reporting these allergies. In comparison, 40.9% of IBS-C patients also had these allergies. However, none of the IBS-D patients reported these allergies, indicating a clear difference between IBS-D and the other two subtypes ( $p < 0.001$ ).

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Our study demonstrates that food allergies are notably more prevalent in IBS-C and IBS-M patients, while they are almost absent in IBS-D cases. This suggests that food sensitivities might play a more substantial role in the symptomatology of IBS-C and IBS-M than in IBS-D.

The post-hoc analyses in our study further explored the differences in food allergies between the IBS subtypes. For egg white and cow's milk allergies, there was a highly significant difference between IBS-D and both IBS-C and IBS-M ( $p < 0.001$ ), but no comparison was made between IBS-C and IBS-M, likely because all patients in these groups had these allergies. Wheat allergy significantly differed between IBS-D, IBS-C, and IBS-M ( $p < 0.001$ ). Still, there was no significant difference between IBS-C and IBS-M ( $p = 0.111$ ), suggesting that wheat allergy is equally prevalent in these subtypes.

For soy, peanut, tomato, and fish allergies, the post-hoc analyses revealed significant differences between IBS-D and the other two subtypes ( $p < 0.001$ ). Additionally, these allergies were significantly more prevalent in IBS-M compared to IBS-C ( $p = 0.001$ ), indicating that while these allergies are common in both subtypes, they are more frequent in IBS-M patients. These findings suggest that IBS-M patients may experience a broader range of food sensitivities compared to those with IBS-C, and both groups differ substantially from IBS-D patients, who have fewer food allergies overall.

Numerous studies have examined the relationship between different food allergies and IBS subtypes. Talley, in 2019, claimed that egg white and wheat allergies also play a significant role, especially in IBS-D, where increased gas production and osmotic effects from the fermentation of wheat-based products might exacerbate symptoms. This contrasts our study, which found no cases of IBS-D. Gluten-containing wheat can trigger immune-mediated as well

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as non-immune-mediated reactions, which can contribute to bloating, pain, and changed bowel habits in vulnerable IBS patients [23].

It's commonly known that dairy products, especially cow's milk, can cause gastrointestinal distress in people with IBS. This could be because of lactose intolerance or an allergy to the protein found in cow's milk [24]. In contrast to our study, this reaction appears highly prominent in IBS-D and IBS-M due to these subtypes' rapid gut motility and sensitivity.

Although they are not as common as dairy and wheat allergies, allergies to soy, peanuts, and fish can nevertheless be rather severe. Allergies to soy and peanuts can trigger immunological reactions that exacerbate intestinal inflammation. This can be troublesome to those with IBS-C because inflammation can worsen bowel movements [25].

Although less research has been done on fish allergies and IBS, it is known that they can cause adverse responses in those who are sensitive, which can exacerbate constipation and diarrhea by inducing inflammatory responses in the gastrointestinal tract [26]. Also, tomato has been linked with the exacerbation of IBS manifestation in certain instances despite not being a prevalent allergy in the general population. The IBS-C and IBS-D subtypes may experience symptoms due to their acidity and possible allergic qualities, while the precise processes remain unknown. [27]

## Conclusions

The study demonstrates that the IBS patients were found to have clear food allergies that had a potential role in exacerbating IBS symptoms. There is a significant link between specific food allergies and IBS subtypes, particularly IBS-C and IBS-M, compared to IBS-D. The crucial differences in food allergies between IBS subtypes underscore the importance of personalized dietary management. Educating IBS patients on the potential impact of food

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allergens and the benefits of elimination diets may improve overall outcomes. Future studies should include a larger sample size and extended periods to confirm these findings and provide more robust conclusions.

## Abbreviations

BSS: Bristol Stool Scale, FGIDs: Functional gastrointestinal disorders, GI: Gastrointestinal, IBS: Irritable bowel syndrome, IBS-C: IBS with predominant Constipation, IBS-D: IBS with predominant Diarrhea, IBS-M: IBS Mixed bowel habit, IBS-U: IBS Unclassified, IgE: Immunoglobulin E, SD: Standard deviation, SPSS: Statistical Package for Social Sciences, REC: The Research Ethics Committee.

## Footnotes.

Ahmed Fathy (Assistant professor of internal medicine, gastroenterology, and hepatology unit), Samah Soliman (Professor of gastroenterology, hepatology, and infectious diseases), and Amany Mohamed Abdalla (Assistant professor of family medicine) were the peer reviewers.

**E- Editor:** Salem Youssef Mohamed, Osama Ahmed Khalil, Amany Mohammed.

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## Ethical approval:

The Research Ethics Committee (REC) at the Faculty of Medicine, Ain Shams University, under the supervision of Prof. Fathy Tash, approved this study with **No. MS 875/ 2022/2023**.

Per the regular operating procedures of both the institution and the REC, the REC does not release the names of its members. Each participant provided informed approval for data analysis.



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### **Study protocol:**

In adherence to the principles outlined in the Helsinki Declaration, the study protocol was implemented with approval from the institutional review board. Before commencing the research, written consent was obtained from the patients to utilize their clinical information.

**Data and materials availability:** The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

**Funding:** This study had no funding from any resource.

This work was done according to the **STROBE** guidelines.

### **Authors' contributions**

Hamza A.M. collected and followed up on the patients, carrying out the requested investigations. Nashaat E.H., El-Gaaly S.A., and Elfors M.A. shared in following up on the patients and analyzing the collected data. All authors authorized the manuscript.

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