EVALUATION OF ASSOCIATIONS BETWEEN DIET AND GASTROINTESTINAL DISORDERS IN SAUDI ARABIA

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Abstract. Gastrointestinal (GI) disorders are a public health problem in Saudi Arabia and diet may influence these conditions. In this study we aimed to evaluate associations between diet and GI disorders among Saudi adults in order to inform efforts to control and prevent these conditions. Study subjects were recruited from the Aseer Region, Saudi Arabi using online surveys distributed via social media platforms and institutional mailing lists of King Khalid University. Inclusion criteria for study subjects were: being aged ≥18 years, living in the Aseer Region, being willing and giving consent to participate in the study. Exclusion criteria for study subjects were: being unwilling to participate in the study, not completing the required questionnaire and having a serious health condition that could confound the dietary assessment. The minimum number of study subjects calculated to be needed for the study was 423. Each subject was asked to complete a self-administered questionnaire that was previously validated, adapted and pilot tested among 20 residents from the study area who met inclusion and exclusion criteria for study subjects. This cross-sectional study was conducted during January-June 2025. The questionnaire asked about consumption of fruits, vegetables, grains, dairy products, proteins/meats, sugary foods, fats and fast food. It also asked about physical activity level, smoking status, weight and height. A body mass index (BMI) was calculated from the weight and height. Dietary intake of each of the recorded items was classified as never, low (1-2 times/week), moderate (3-6 times/week) and high (≥7 times/week) following Food and Agricultural Organization (FAO), World Health Organization (WHO) guidelines. Consumption of sugary items, fats and fast food were categorized into low/healthy, moderate and high/unhealthy consumption. Physical activity was categorized as low,

moderate, or high following WHO recommendations, with thresholds based on weekly minutes of moderate and vigorous activity. BMI was categorized as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥30.0 kg/m²). Subjects were asked if they had been diagnosed with any of the following gastrointestinal (GI) disorders: constipation, functional dyspepsia, gastritis, gastroesophageal reflux disease (GERD), inflammatory bowel disease (IBD Crohn's or ulcerative colitis), irritable bowel syndrome (IBS), and peptic ulcer disease (PUD). Associations between diet and these specific GI disorders were assessed using multivariable logistic regression analysis and reported as adjusted odds ratios (aOR) with 95% confidence intervals (CI). A total of 430 subjects were included in the study, 256 (59.5%) females. The mean (±standard deviation) age of study subjects was 36.9 (±10.8) (range: 18-65) years. Twenty-seven subjects (6.3%) never consumed fruit. 328 (76.3%), 58 (13.5%) and 17 (3.9%) had low, moderate and high fruit intake, respectively. 15 (3.5%) never consumed vegetables. 272 (63.3%), 99 (23.0%) and 44 (10.2%) had low, moderate and high vegetable intake, respectively. Three subjects (0.7%) never consumed grains. Eighty (18.6%), 191 (44.4%) and 156 (36.3%) had low, moderate and high grain intake, respectively. Nine subjects (2.1%) never consumed protein/meat. 132 (30.7%), 188 (43.7%) and 101 (23.5%) had low, moderate and high protein/meat intake, respectively. Nine subjects (2.1%) never consumed dairy products. 262 (60.9%), 121 (28.2%) and 38 (8.8%) had low, moderate and high dairy intake, respectively. Fifteen subjects (3.5%) never consumed sugary foods. 222 (51.7%), 127 (29.5%) and 66 (15.3%) had low, moderate and high sugary food intake, respectively. Eight subjects (1.9%) never consumed fat. 234 (54.4%), 138 (32.1%) and 50 (11.6%) consumed low, moderate and high fat intake; thirty-two subjects (7.4%) never consumed fast-food. 309 (71.9%), 81 (18.8%) and 8 (1.9%) had low, moderate and high fast-food intake, respectively. 117 subjects (27.2%) reported having been diagnosed with a GI disorder: 12 (2.8%) had constipation, 9 (2.1%) had functional dyspepsia, 55 (12.8%) had gastritis, 17 (4.0%) had GERD, 1 (0.2%) had IBD, 18 (4.2%) had IBS and 5 (1.2%) had PUD. Subjects with low fruit intake were significantly more likely to have a GI disorder than those on a moderate to high fruit diet (aOR = 0.685, 95%CI: 0.497-0.945, *p*-value = 0.021). Females were significantly less likely than males to have a GI disorder (aOR = 0.490; 95%CI: 0.273-0.878, *p*-value = 0.017). In

summary, subjects with a low fruit diet were significantly more likely to have a GI disorder and females were significantly less likely to have a GI disorder. We conclude, subjects with a low fruit diet and males in the study population should be encouraged to consume more fruit. Further studies are needed to determine if people with a low fruit diet and males consume more fruit if this will reduce the chance of developing a GI disorder.

Keywords: dietary diversity, gastrointestinal disorders

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INTRODUCTION

Gastrointestinal (GI) disorders are common worldwide, including in Saudi Arabia (Alhazmi *et al*, 2014). Common GI disorders include irritable bowel syndrome (IBS), dyspepsia, constipation, gastroesophageal reflux disease (GERD) and gastritis, inflammatory bowel disease (IBD) (Marano *et al*, 2025; Canavan *et al*, 2014; Nirwan *et al*, 2020). High fiber diets are associated with a lower risk of constipation and IBS (Han *et al*, 2023; Conlon and Bird, 2025). A high fat diet has been associated with developing GERD (Nirwan *et al*, 2020; Ocvirk *et al*, 2019). A diet high in refined and processed foods has been found to be associated with gastrointestinal dysfunction through microbial dysbiosis and inflammation, influencing IBS and IBD (Popkin *et al*, 2020; Zeng *et al*, 2017). Fermented foods, such as yogurt, kefir, kimchi, sauerkraut, miso and tempeh, provide probiotics that may improve gut microbiota and have been shown to alleviate symptoms in IBS and IBD cases (Conlon and Bird, 2025).

IBS affects approximately 10-15% of adults worldwide (Canavan *et al*, 2014) and GERD affects 13-20% (Nirwan *et al*, 2020). Gastritis is

also common but its prevalence is not well documented (Ahuja *et al*, 2023).

In Saudi Arabia, traditional diets based on whole grains, legumes, seasonal fruits, dairy and fish have been increasingly replaced by energy-dense, nutrient-poor foods, such as refined carbohydrates, processed meat, fast food and sugar-sweetened beverages (FAO, 2018; CDC, 2014). These changes coincide with a sedentary lifestyle and rising obesity rates (Ng *et al*, 2011), with more than one-third of Saudi adults classified as obese (WHO, 2025). One study of Saudi students found low fruit and vegetable intake and frequent consumption of fast food (Al-Qahtani, 2016). Poor fruit and vegetable intake and frequent consumption of fast food have been reported to be associated with GI disorders (Aljahdali and Bawazeer 2022).

Surveys are commonly used to evaluate the relationship between diet and GI disorders (Cade *et al*, 2002; Dolui *et al*, 2023). Food frequency questionnaires (FFQs) allow evaluation of associations between fiber, fat and processed food consumption and GI disorders (Han *et al*, 2023; Ocvirk *et al*, 2019; Alahmari, 2024). Smoking and physical activity have also been found to be associated with gastrointestinal health (Dello Russo *et al*, 2023; Conlon and Bird, 2025).

Non-communicable diseases are a major public health problem in Saudi Arabia. Eighteen to 25% of Saudis have type 2 diabetes mellitus, cardiovascular disease or a related health condition (Ng *et al*, 2011, Aljahdali and Bawazeer 2022). Frequent consumption of refined carbohydrates, fats and processed foods is strongly associated with type 2 diabetes mellitus and cardiovascular disease (Ng *et al*, 2011, Alhazmi *et al*, 2014). The association between diet and metabolic diseases has been documented among Saudis but few studies have examined the relationship between diet and GI disorders among Saudis. There is a need to evaluation the potential association between diet and GI

disorders among Saudis in order to inform efforts to prevention and treat GI disorders in this population.

In this study we aimed to evaluate associations between diet and GI disorders among adults in the Aseer region of Saudi Arabia, to inform public health programs to improve management and prevention of GI disorders.

MATERIALS AND METHODS

Study design and population

We conducted a community-based cross-sectional study among Saudi adults in the Aseer region of southwestern Saudi Arabia during January-June 2025. Inclusion criteria for study subjects were: 1) being aged ≥18 years, 2) currently residing in the Aseer region of Saudi Arabia and 3) being willing to give informed consent for inclusion in the study. Exclusion criteria for study subjects were: 1) refusing to participate in the study, 2) failing to complete the questionnaire and 3) having a diagnosis of a severe chronic illness, such as cancer, that could confound dietary assessment.

Study subjects were recruited from the Aseer Region of Saudi Arabi using online surveys distributed via social media platforms and institutional mailing lists of King Khalid University. This approach may have introduced selection bias toward younger, computer-literate individuals with regular internet access. To mitigate this bias, subjects who were recruited from the mailing list had the questionnaire administered via face-to-face interviews by trained Public Health students.

Sample size determination

The minimum number of subjects required to achieve statistical significance was calculated using Yamane's formula with a 5% margin of error and a 95% confidence level (Cade *et al*, 2002); this was determined to be 423 subjects. To compensate for potential non-responses, 437 subjects were recruited into the study (Dolui *et al*, 2023).

Data collection tool

Each subject was asked to complete a self-administered questionnaire adopted from previous validated studies and modified to include locally consumed foods (Cade *et al*, 2002; Craig *et al*, 2003; FAO, 2018). The questionnaire was prepared in Arabic and pilot tested among 20 adults from the target population meeting inclusion and exclusion criteria to ensure applicability to the study population. Responses from the pilot study were excluded from the final analysis. Internal consistency was assessed using the Cronbach's alpha, yielding a reliability of $\alpha = 0.87$.

Questionnaire content

Each subject was asked to complete 2 questionnaires. The first questionnaire consisted of 3 parts: 1) subject sociodemographic characteristics, consisting of age, sex, marital status, education level, occupation and income level; 2) lifestyle and health characteristics, consisting of family history of GI disorders, history of smoking and physical activity and the current height, weight and body mass index (BMI) as classified by World Health Organization criteria (WHO, 2020); and 3) history of a GI disorder, asking if the respondent had ever been diagnosed by a physician as having constipation, functional dyspepsia, gastritis, GERD, IBD, IBS or PUD.

The second questionnaire consisted of a semi-quantitative FFQ adapted from FAO dietary guidelines, consisting of questions about the frequency of consuming grains, fruits, vegetables, legumes, dairy products, meats, fats, sugary foods and fast foods (FAO, 2018). The frequency of consumption of all these items was classified as: never, low (1-2 times/week), moderate (3-6 times/week), and high (≥7 times/week). For sugary foods, fats, and fast foods, intake was further categorized as healthy (never or low) and unhealthy (moderate or high). Physical activity in this study was classified according to the WHO Global Guidelines on

Physical Activity and Sedentary Behavior (WHO, 2020; Bull *et al*, 2020) as low (<150 minutes of moderate physical activity per week), moderate (150-300 minutes of moderate-intensity aerobic or 75-150 minutes of vigorous-intensity activity per week and high (≥300 minutes/week of moderate activity or >150 minutes of vigorous-intensity activity per week). BMI was categorized as underweight (<18.5 kg/m²), normal (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥30.0 kg/m²) (WHO, n.d.).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26 (International Business Machines Corporation, Armonk, NY). Descriptive statistics (means, standard deviations, frequencies and percentages) were used to summarize subject characteristics. Bivariate analyses were conducted using Chi-square tests or Fisher's exact tests where applicable for categorical variables and independent *t*-tests for continuous variables to determine associations between sociodemographic factors and dietary factors and the development of gastrointestinal (GI) disorders. Those meeting significance on bivariate analysis were included in multivariable logistic regression analysis to determine associations between selected dietary factors and GI disorders. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) were calculated controlling for age, sex, BMI, physical activity level, smoking status and family history of GI disorders. Statistical significance was set at p-value <0.05.

All dietary factors were classified into 4 categories as never, low (1-2 times/week), moderate (3-6 times/week) and high (≥7 times/week) (FAO, 2018). Fruit intake was classified as low (≤2 times per week), moderate (3-5 times per week) and high (≥6 times per week) (WHO, 2020; FAO, 2018).

Smoking status was classified as "yes" for current smokers and "no" for non-smokers (CDC, 2014).

Ethical considerations

Ethical approval for this study was obtained from the King Khalid University Research Ethics Committee (Approval No: ECM#2024-3190). Digital informed consent was obtained from each subject prior to inclusion in the study.

RESULTS

Subject characteristics

A total of 430 subjects were included in the study, 256 (59.5%) females. The mean (±standard deviation (SD)) age of subjects was 36.9 years (±10.8) (range: 18-65) years. Forty-five subjects (10.5%) were aged 18-25 years, 130 (30.2%) were aged 26-35 years, 164 (38.1%) were aged 36-45 years and 91 (21.2%) were aged >45 years. 296 subjects (68.8%) were married, 317 (73.7%) had an undergraduate degree and 45 (10.5%) had a postgraduate degree, 227 (52.8%) were employed in government positions, 104 (24.2%) were unemployed and 369 (85.8%) were non-smokers. 155 subjects (36.0%) had low, 256 (60.0%) had moderate and 19 (4.0%) had high physical activity levels per week. The mean (±SD) body mass index (BMI) of study subjects was 27.6 (±4.3) kg/m² (Table 1). 117 subjects

Table 1

Sociodemographic characteristics, dietary habits, and prevalence of GI disorders among study subjects (N = 430)

Variable	Frequency *n* (%)
Age	
18-25 years	45 (10.5)
26-35 years	130 (30.2)
36-45 years	164 (38.1)
>45 years	91 (21.2)

Table 1 (cont)

Variable	Frequency *n* (%)
Gender	
Male	174 (40.5)
Female	256 (59.5)
Marital status	
Single	134 (31.2)
Married	296 (68.8)
Weight category	
Underweight	5 (1.2)
Normal	110 (25.6)
Overweight	207 (48.1)
Obesity	108 (25.1)
Education level	
Intermediate school or less	6 (1.4)
High school	62 (14.4)
Graduate	317 (73.7)
Postgraduate	45 (10.5)
Occupation	
None	104 (24.2)
Government employer	227 (52.8)
Private sector	62 (14.4)
Student	24 (5.6)
Retired	13 (3.0)
Smoker	
No	369 (85.8)
Yes	61 (14.2)

Table 1 (cont)

Variable	Frequency *n* (%)
Monthly income	
< SAR5,000	49 (11.4)
SAR5,000-10,000	237 (55.1)
> SAR10,000	144 (33.5)
Physical activity level	
Low	155 (36.0)
Moderate	256 (60.0)
High	19 (4.0)
Meals/day	
1	16 (3.7)
2	247 (57.5)
3	152 (35.3)
>3	15 (3.5)
Gastrointestinal disorder	
No	313 (72.8)
Yes	117 (27.2)

Weight category was determined by the participant's body mass index (BMI): underweight: <18.5 kg/m², normal weight: 18.5-24.9 kg/m², overweight: 25.0-29.9 kg/m^2, obese: ≥30.0 kg/m^2 (WHO, n.d.)

Physical activity was categorized as low, moderate, or high following World Health Organization's recommendations (WHO, 2020), with thresholds based on weekly minutes of moderate and vigorous activity.

kg/m^2: kilogram per square meter; SAR: Saudi Riyal

(27.2%) reported having been diagnosed with a GI disorder: 12 (2.8%) had constipation, 9 (2.1%) had functional dyspepsia, 55 (12.8%) had gastritis, 17 (4.0%) had GERD, 1 (0.2%) had IBD, 18 (4.2%) had IBS and 5 (1.2%) had PUD (Table 2).

Twenty-seven subjects (6.3%) never consumed fruit. 328 (76.3%), 58 (13.5%) and 17 (3.9%) had low, moderate and high fruit intake, respectively. 15 (3.5%) never consumed vegetables. 272 (63.3%), 99 (23.0%) and 44 (10.2%) had low, moderate and high vegetable intake, respectively. Three subjects (0.7%) never consumed grains. Eighty (18.6%), 191 (44.4%) and 156 (36.3%) had low, moderate and high grain intake, respectively. Nine subjects (2.1%) never consumed protein/meat. 132 (30.7%), 188 (43.7%) and 101 (23.5%) had low, moderate and high protein/meat intake, respectively. Nine subjects (2.1%) never consumed dairy products. 262 (60.9%), 121 (28.2%) and 38 (8.8%) had low, moderate and high dairy intake, respectively. Fifteen subjects (3.5%) never consumed sugary foods. 222 (51.7%), 127 (29.5%) and 66 (15.3%) had low,

Table 2

Diagnosed gastrointestinal disorders among study subjects (N = 430)

Gastrointestinal disorders	Frequency *n* (%)
Constipation	12 (2.8)
Functional dyspepsia	9 (2.1)
Gastritis	55 (12.8)
Gastroesophageal reflux disease	17 (4.0)
Inflammatory bowel disease	1 (0.2)
Irritable bowel syndrome	18 (4.2)
Peptic ulcer disease	5 (1.2)

moderate and high sugary food intake, respectively. Eight subjects (1.9%) never consumed fat. 234 (54.4%), 138 (32.1%) and 50 (11.6%) consumed low, moderate and high fat intake. Thirty-two subjects (7.4%) never consumed fast-food. 309 (71.9%), 81 (18.8%) and 8 (1.9%) had low, moderate and high fast-food intake, respectively (Table 3).

Bivariate analysis

On bivariate analysis, subjects with GI disorders were significantly more likely than those without GI disorders to have lower fruit consumption (p-value = 0.049), higher fatty food consumption (p-value = 0.043), and higher fast-food consumption (p-value = 0.030) (Table 4). They were also significantly more likely to be older (p = 0.018) and have a higher mean BMI (p-value = 0.026). No significant differences were observed for gender, marital status, smoking status or income.

Multivariable analysis

On multivariable logistic regression analysis after adjusting for age, sex, BMI, physical activity level, smoking status and family history of GI disorders, the only dietary factor significantly associated with GI disorders was low fruit intake (aOR = 0.685, 95% CI: 0.497-0.945, p-value = 0.021). Female subjects were significantly less likely than male subjects to have a GI disorder (aOR = 0.490, 95%CI: 0.273-0.878, p-value = 0.017) (Table 5).

DISCUSSION

In our study, low fruit intake was significantly associated with a GI disorder. A previous study (Han *et al*, 2023) reported low consumption of fruits was associated with impaired gut health. Fruit provides soluble and insoluble fiber that promote regular bowel movements and support growth of beneficial gut bacteria (Azzeh *et al*, 2017; Ocvirk *et al*, 2019; Alahmari, 2024). Dietary fiber from fruit also contributes to the production of short-chain fatty acids, such as butyrate, which reduces intestinal inflammation

Table 3

Classification of food consumption frequencies and healthiness categories (N = 430)

Food Group	Frequency of consumption, *n* (%)				Consumption health categories	
	Never	Low (1-2 times/ week)	Moderate (3-6 times/ week)	High (≥7 times/ week)	Healthy (Never + Low)	Unhealthy (Moderate + High)
Fruit	27 (6.3)	328 (76.3)	58 (13.5)	17 (3.9)	75 (17.4)	355 (82.6)
Vegetables	15 (3.5)	272 (63.3)	99 (23.0)	44 (10.2)	143 (33.3)	287 (66.7)
Grains	3 (0.7)	80 (18.6)	191 (44.4)	156 (36.3)	347 (80.7)	83 (19.3)
Protein/Meat	9 (2.1)	132 (30.7)	188 (43.7)	101 (23.5)	289 (67.2)	141 (32.8)
Dairy	9 (2.1)	262 (60.9)	121 (28.2)	38 (8.8)	159 (37.0)	271 (63.0)
Sugary food	15 (3.5)	222 (51.7)	127 (29.5)	66 (15.3)	237 (55.2)	193 (44.8)
Fatty food	8 (1.9)	234 (54.4)	138 (32.1)	50 (11.6)	242 (56.3)	188 (43.7)
Fast food	32 (7.4)	309 (71.9)	81 (18.8)	8 (1.9)	341 (79.3)	89 (20.7)

Table 4

Bivariate analysis of associations with GI disorders (N = 430)

Variables	χ^2	df	*p*-value	Mean difference
Age	-2.3	428	0.01	-0.2
Body mass index	-2.2	428	0.02	-0.1
Fruit consumption	1.9	428	0.04	0.1
Fatty food consumption	-2.0	428	0.04	-0.2
Fast food consumption	-2.1	428	0.03	-0.2

df: degrees of freedom

Table 5

Adjusted logistic regression analysis of factors associated with gastrointestinal disorders (*n* = 430)

Variables	B	SE	aOR (exp(B))	95% CI	*p*-value
Fruit consumption	-0.378	0.164	0.685	0.497 - 0.945	0.021
Fat consumption	0.266	0.153	1.305	0.966 - 1.763	0.083
Fast food consumption	1.421	1.277	4.140	0.339 - 50.580	0.266
Female gender	-0.713	0.298	0.490	0.273 - 0.878	0.017

aOR (exp(B)): adjusted odds ratio exponentiation of B, representing the change in odds of the outcome for each unit change in the predictor; B: unstandardized regression coefficient indicating a change in the log odds of the outcome for a one-unit change in the predictor variable; CI: confidence interval; SE: standard error

and maintains intestinal barrier integrity (Ocvirk *et al*, 2019). Fruits also provide polyphenols that enhance microbial diversity, which helps maintain gut barrier integrity, modulates immune responses and may protect against constipation and diarrhea (Azzeh *et al*, 2017; Alahmari, 2024). A diet rich in fruits has been associated with a lower risk of functional gastrointestinal symptoms (Alahmari, 2024; Azzeh *et al*, 2017). Inadequate fruit consumption, which results in insufficient fiber and fermentable substances intake and altered gut motility and sensitivity, has been reported to be significantly associated with functional GI disorders, such as IBS and dyspepsia (Han *et al*, 2023). A study from Saudi Arabia reported a diet rich in fruit is associated with a lower risk of GI disorders, including GERD and PUD, highlighting the potential protective role of fruit consumption on gastrointestinal health (Azzeh *et al*, 2017).

In our study, low fruit intake was the only dietary factor significantly associated with a GI disorder but consumption of vegetables was not significantly associated with GI disorders, in contrast to the results of previous studies showing a significant association between consumption of vegetables and a reduced risk of constipation and irritable bowel syndrome (IBS) (Azzeh *et al*, 2017; Xie *et al*, 2020; Han *et al*, 2023; Alahmari, 2024; Conlon and Bird, 2025).

In our study, we found no significant association between consumption of whole grain and GI disorders. This is in contrast to other studies showing a significant association between consumption of whole grains and improved bowel function (Ocvirk *et al*, 2019; Xie *et al*, 2020).

In our study, we found no significant association between consumption of meat and dairy products and GI disorders. Review of the literature shows a mixed result. Some studies have found diets high in processed meats have been associated with inflammation and microbial dysbiosis that can

exacerbate GI dysfunction (Popkin *et al*, 2020; Xie *et al*, 2020). A previous study found consumption of yogurt and kefir improves gut microbiota and alleviates symptoms in IBS and IBD (Conlon and Bird 2025).

In our study, we found no significant associations between consumption of sugary foods, fats and fast foods and the development of GI disorders. However, previous studies have shown a significant association, showing these foods contribute to GI dysfunction through dysbiosis, inflammation and altered motility (Ocvirk *et al*, 2019; Nirwan *et al*, 2020; Popkin *et al*, 2020; Zeng *et al*, 2017). High fat diets have been found to be associated with GERD (Nirwan *et al*, 2020; Ocvirk *et al*, 2019). Frequent fast-food consumption has been reported to be associated with GI symptoms (Aljahdali and Bawazeer 2022). The lack of significant associations in our study may be due to subject underestimation of intake frequency or cultural dietary differences between the Aseer population and the populations of those other studies.

In our study, females were significantly less likely than males to have a GI disorder, unlike the findings of a previous study that reported a higher prevalence of IBS among women than men (Marano *et al*, 2025). In our study, we did not distinguish among the different types of GI disorders, limiting direct comparison with other studies. This may explain the difference between our study results and other study results. Cultural, gender, and dietary differences may vary by population, culture and diet (Alhazmi *et al*, 2014).

Strengths of our study were its community-centered design, its use of a validated questionnaire adapted for local dietary habits and adjusted for multiple confounders. Weaknesses of this study were the cross-sectional design which precludes determining causality and bidirectional associations and the GI disorders were self-reported and subject to recall or reporting bias.

In summary, we found in our study population low fruit intake was significantly associated with having a GI disorder and female subjects were significantly less likely to have GI disorders. We conclude, efforts to prevent and manage GI disorders should focus on increasing fruit consumption to high levels, especially among males. Further studies are needed to determine if implementing these interventions can reduce the prevalence of GI disorders in the study population.

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CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data sets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Any shared data will be fully anonymized and dissociated from all identifying characteristics to comply with ethical and privacy requirements.

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