Original Article

The Relation between Dietary Patterns and Functional Gastrointestinal Disorders among Iranian Military Men

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Abstract

Background: Assessing the relation between dietary habits and functional gastrointestinal disorders (FGIDs) is less investigated among military personnel. In this study, we aimed to evaluate the association of certain eating patterns and FGIDs in Iranian army men. **Materials and Methods:** This cross-sectional study was performed on 600 army personnel working in Kerman ground forces military station number 05, Iran. Participants were asked to define their weekly breakfast consumption, lunch intake time, and chewing efficiency. FGIDs were categorized as four groups including functional dyspepsia (FD), irritable bowel syndrome (IBS), functional constipation (FC) and functional diarrhea (FDi) diagnosed by Rome III criteria. Relation between variables was assessed through crude and multiple stepwise adjusted models. **Results:** The prevalence of FD, IBS, FC, and FDi in our study was 20%, 32.3%, 3%, and 53.2%, respectively. After adjustment of all potential confounding variables, more weekly breakfast consumption was associated with decreased FDi prevalence (odds ratio [OR]: 0.57, 95% confidence interval [CI] = 0.38–0.84, P = 0.005). Slowly lunch consumption declined prevalence of IBS (OR: 0.33, 95% CI = 0.13–0.84, P = 0.02). Individuals chewing their meals well had a lower percentage of IBS, FC, and FDi (OR: 0.53, 95% CI = 0.33–0.83, P = 0.006; OR: 0.24, 95% CI = 0.06–0.89, P = 0.03; and OR: 0.52, 95% CI = 0.34–0.79, P = 0.003, respectively). **Conclusions:** This study suggested that increasing breakfast intake, slowly lunch consumption, and better food chewing could be effective decreasing FGIDs' prevalence and increasing army crews' quality of lives and work efficiency. Further studies required to confirm this relationship and define accurate pathophysiological mechanisms.

Keywords: *Dietary patterns, functional constipation, functional diarrhea, functional dyspepsia, functional gastrointestinal disorders, irritable bowel syndrome, military*

Introduction

Functional gastrointestinal disorders (FGIDs) are a group of disorders characterized by chronic or recurrent gastrointestinal[1] symptoms in the absence of any organic pathologies.[2,3] These diseases are further classified to six main categories including esophageal, gastroduodenal, bowel, biliary, anorectal, and abdominal pain.[3] These entities caused a significant number of visits annually and had a negative impact on individuals' quality of life, especially in military personnel.[2-6] For instance, a population-based study revealed that FGIDs were present in 23% of Chinese aircrew and ground personnel.[7] Moreover, 50% of German soldiers seeking health care for GI symptoms were finally diagnosed as having FGIDs.[8] In spite of not exactly proven their pathophysiological mechanisms, several possible theories exist including genetic factors, gut-brain axis dysfunction, disruption of mucosal barrier, inflammation and microbiota alteration, GI dysmotility, and visceral hypersensitivity.[2,3,9] Due to anonymous etiology, diagnosis is made clinically and mainly through Rome diagnostic criteria.[2] Four most common FGIDs including functional dyspepsia (FD), irritable bowel syndrome (IBS), functional constipation (FC), and functional diarrhea (FDi) have considerable prevalence of 29.9%, 1.1–25%, 2.4–11.2%, and 2% in general Iranian population, respectively.[1,10-12] These diseases cause a great governmental economic burden.[6,13] For example, a total 6-month costs of IBS, FC, and FDi in Iran were estimated to be 160, 147, and 47$ purchasing power parity.[14] Although several risk factors announced to cause these disorders such as

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postinfection and psychosocial and mental health problems, one of the most common factors contributing to this relation is dietary habits.[3,6,15] Due to strictly imposed discipline presenting in all military stations, major eating habits could be effective in pathogenesis of FGIDs and consequently on soldiers' cognitive function and physical activity in a way that according to study done by Purvis *et al.*, soldiers eating more breakfasts per week had a higher score of healthy diet and were more likely to pass their specific physical fitness tests.[16] To best of our knowledge, there is no study evaluating the relation of dietary habits and FGIDs among Iranian military men. In this study, we aimed to investigate the relation between FD, IBS, FC, and FDi with major feeding behaviors including breakfast consumption, lunch intake time, and chewing efficiency among Iranian military men.

Materials and Methods

Study population

This cross-sectional study was performed on military personnel who aged at least 18 years. Iranian army adults working in ground force army stations in Kerman number 05 were recruited by simple randomization way from February to May 2018. With statistic corresponding to the level of confidence of 1.96, standard deviation (SD) of 0.5, and optimal difference of 0.04, the sample size was calculated to be 600. Due to the possibility of incompleteness in completing the desired information in order to gather data, Self-administered questionnaire was given to 700 participants asking questions about demographic information and dietary behaviors. Moreover, a series of questions evaluating four most common FGIDs including FD, IBS, FC, and FDi was distributed among those individuals. The questionnaire used in this study was in the context of "study on the epidemiology of psychological, alimentary health and nutrition" (SEPAHAN). They reported that while they wanted to face validate the questionnaire, most participants would not be able to discriminate between rating scales in original Rome III criteria. Therefore, a four-item scale (never or rarely, sometimes, often, and always) was designed, and our data gathering was performed according to this Persian validated version of Rome III criteria.[17] Each participant received an informed consent form. Any official employees or conscripts in the past 6 months of his duty due to the presence of programmed dietary habits, homogeneous eating time, and lifestyle pattern who willing to fulfill the questionnaire was eligible for enrollment in the study. Our response rate was 93% (657 out of 700). Incompleteness of questionnaire or any histories of the followings within the past 3 months before study initiation including blood in stools, proved anemia, temperature of more than 38°C, unexplainable weight reduction, previous abdominal surgeries, or waking up because of abdominal pain excluded participants from the project. Finally, after merging of all information, data of 600 individuals were available for analysis. This study was approved by the Ethics Committee of Aja University of Medical Sciences.

Assessment of dietary behaviors

Food frequency questionnaire was used to collect data about dietary habits.[17] To assess breakfast consumption, individuals were asked to specify the number of breakfasts eating per week from a two-scale item (<5 and ≥5 times/week). To define the time needed to eat lunch, participants were asked to quantify the approximate time taking long consuming this variable. The answers were "<10 min," "10–20 min," and ">20 min." Data of chewing efficiency assessment were obtained through the question "how thoroughly do you chew foods." Participants were able choosing from answers including "not well," "well," and "very well."

Assessment of functional gastrointestinal disorders

A validated Iranian version of Rome III criteria[17] was utilized defining four common FGIDs including FD, IBS, FC, and FDi. A four-item scale was used measuring frequency of symptoms consisting of "never," "sometimes," "often," and "always." FD was assessed as the presence of any criteria including fullness, early satiety, or abdominal pain or heartburn at least often during 3 months before initiation of the study. IBS was determined as having abdominal pain concurrently with improvement with defecation or changing in stool consistency or frequency at least sometimes within 3 months before the start of project. FC was specified as the presence of more than one item of the followings at least often 3 months ago from study including stool frequency of <3 times per week, presence of hard stools, excessive strain during defecation, feeling of incomplete evacuation, feeling of stool stopping, usage of finger manipulation in order to defecate and problem in relaxing body permitting stool passage in the absence of both watery stools, and IBS diagnostic criteria. FDi was assessed as the presence of at least one criterion of 4 or more than 4 times of daily stools, existence of watery stools, or being in hurry for defecation at least sometimes during 3 months before the study initiated.

Assessment of other variables

Information about demographic variables including age, weight, height, marital status, education level, smoking, and diabetes were gathered through a self-administered questionnaire. Body mass index (BMI) was calculated by division of body weight in kilograms over height in squares of meter (kg/m^2). Information on daily main meals and snack consumption was obtained by a three (one, two, or three) and four-item (no snack, one or two, three to five, and more than five), respectively. Regularity of eating was assessed by a question "how often do you eat your meals regularly," and the answers were "never," "sometimes," "often," or "always." Participants were also asked to specify

the approximate time of eating dinner (<10 min, 10–20 min and more than 20 min). Intra-meal fluid intake data were collected with a four-item scale (never, sometimes, often, or always). Assessing information on fried and spicy food consumption was obtained with the question how often do you eat fried and spicy food, respectively, and the answers were <5 times or at least 5 times per week.

Statistical analysis

Categorical and continuous variables were reported as frequencies (percentage) and mean ± SD, respectively. The Chi-square test was used examining the relation of different categories of dietary habits with FGIDs. To evaluate the relation between each desired variable including breakfast consumption, lunch intake time, and chewing efficiency with FD, IBS, FC, and FDi, logistic regression with different models were utilized. First, the relationship was assessed in crude model. Then, age was adjusted in the model 1. In model 2, age and BMI were adjusted. Moreover, further adjustment for marital status, education level, cigarette smoking, and diabetes were done in model 3. Finally, additional adjustment for main meal and snack frequency, eating regularity, breakfast consumption, lunch and dinner intake time, chewing efficiency, intra-meal fluid intake, and fried and spicy food intake with the exception of desired variable was done in the last model. All analyses were performed using the Statistical Package for the Social Sciences (SPSS Inc., version 22.0, Chicago, IL, USA), and $P < 0.05$ was considered statistically significant.

Results

The mean age and weight of our participants were 26 ± 6.9 years and 71.8 ± 11.3 kg, respectively. General characteristics of study participants across different categories of dietary habits (breakfast consumption, lunch intake time, and chewing efficiency) are shown in Table 1. In comparison with participants who ate <5 breakfasts per week, those consuming at least 5 ones were mostly nonsmokers and married. In terms of lunch intake time, any individuals in the category of more than 20 min had higher means of weight and BMI and were less educated compared with those eating lunch <10 min. Persons chewing their meals very well comparing to ones chewing not well were younger and less educated, and most of them were smokers and diabetics. Furthermore, married individuals were mostly consumed regular breakfasts per week, but lunch intake time or chewing efficiency was not statistically significant compared to nonmarried ones. About 8.2% and 65.6% of participants with education degree of at least diploma ate their lunch slowly and very well, respectively. In terms of smoking status, 28.3% and 20.8% of smokers consumed regular weekly breakfasts and ate their meals very well. The only significant relation on diabetic patients was in terms of chewing efficiency showing that 32% of participants suffering from this disease consumed foods efficiently (data not shown).

Table 2 provided information about distribution of diet-related behaviors across different categories of breakfast consumption, lunch intake time, and chewing efficiency. Individuals who consumed 5 or more than 5 weekly breakfasts comparing with those of <5 times had more daily usages of main meals and snacks, ate their meals more regularly and slowly, and chewed better in addition to more intake of spicy food. According to their lunch intake time, participants consuming their lunch slowly (more than

Table 1: General characteristics of study participants across categories of breakfast consumption, lunch time, and chewing efficiency

Variables	Breakfast consumption (times/week)			Lunch intake time				Chewing efficiency			
	<5	≥5	*P*	<10 min	10-20 min	>20 min	*P*	Not well	Well	Very well	*P*
Age (year)	25.5±6.2	26.4±7.5	0.3	25.9±6.5	25.7±6.3	27.3±10.2	0.9	27.2±7.4	25.3±6.1	26.6±9.5	0.01
Weight (kg)	71.5±10.6	72.1±11.9	0.7	73.1±11.4	70±11.1	75.3±9.9	<0.001	73.2±12.3	71±10.7	73.1±11.1	0.1
BMI (kg/m^2)	24.1±3.2	24±3.6	0.5	23.8±3.1	23.9±3.6	25.3±3	0.009	24±3.5	23.9±3.3	24.4±3.3	0.7
Marital status (%)											
Single	201 (68.4)	179 (58.5)	0.01	154 (64.2)	190 (64.6)	36 (54.5)	0.2	104 (59.4)	243 (66.8)	33 (54.1)	0.07
Married	93 (31.6)	127 (41.5)		86 (35.8)	104 (35.4)	30 (45.5)		71 (40.6)	121 (33.2)	28 (45.9)	
Education level (%)											
Illiterate	10 (3.4)	22 (7.2)	0.09	7 (2.9)	21 (7.1)	4 (6.1)	<0.001	3 (1.7)	23 (6.3)	6 (9.8)	0.03
Under diploma	67 (22.8)	61 (19.9)		41 (17.1)	61 (20.7)	26 (39.4)		32 (18.3)	81 (22.3)	15 (24.6)	
Diploma or more	217 (73.8)	223 (72.9)		192 (80)	212 (72.1)	36 (54.5)		140 (80)	260 (71.4)	40 (65.6)	
Smoking (%)											
Yes	38 (12.9)	15 (4.9)	0.001	19 (7.9)	24 (8.2)	10 (15.2)	0.1	19 (6.9)	30 (8.2)	11 (18)	0.02
No	256 (87.1)	291 (95.1)		221 (92.1)	270 (91.8)	56 (84.8)		163 (93.1)	334 (91.8)	50 (82)	
DM (%)											
Yes	15 (5.1)	10 (3.3)	0.2	10 (4.2)	9 (3.1)	6 (9.1)	0.08	6 (3.4)	11 (3)	8 (13.1)	0.001
No	279 (94.9)	296 (96.7)		230 (95.8)	285 (96.9)	60 (90.9)		169 (96.6)	353 (97)	53 (86.9)	

BMI: Body mass index, DM: Diabetes mellitus

Table 2: Distribution of participants in terms of diet-related behaviors across categories of breakfast consumption, lunch time, and chewing efficiency

Variables	Breakfast consumption (times/week)			Lunch intake time				Chewing efficiency			
	<5	≥5	*P*	<10 min	10-20 min	>20 min	*P*	Not well	Well	Very well	*P*
Main meal (%)											
1	49 (16.7)	20 (6.5)	<0.001	26 (10.8)	37 (12.6)	6 (9.1)	0.5	14 (8)	50 (13.7)	5 (8.2)	0.1
2	91 (31)	42 (13.7)		60 (25)	57 (19.4)	16 (24.2)		45 (25.7)	78 (21.4)	10 (16.4)	
3	154 (52.4)	244 (79.7)		154 (64.2)	200 (68)	44 (66.7)		116 (66.3)	236 (64.8)	46 (75.4)	
Snack frequency (%)											
0	112 (38.1)	85 (27.8)	0.01	89 (37.1)	88 (29.9)	20 (30.3)	<0.001	63 (36)	123 (33.8)	11 (18)	<0.001
1-2	146 (49.7)	162 (52.9)		115 (47.9)	175 (59.9)	18 (27.3)		86 (49.1)	199 (54.7)	23 (37.7)	
3-5	22 (7.5)	42 (13.7)		26 (10.8)	26 (8.8)	12 (18.2)		17 (9.7)	30 (8.2)	17 (27.9)	
>5	14 (4.8)	17 (5.6)		10 (4.2)	5 (1.7)	16 (24.2)		9 (5.1)	12 (3.3)	10 (16.4)	
Regularity (%)											
Never	80 (27.2)	40 (13.1)	<0.001	65 (27.1)	47 (16)	8 (12.1)	<0.001	54 (30.9)	57 (15.7)	9 (14.8)	<0.001
Sometimes	142 (48.3)	117 (38.2)		105 (43.8)	134 (45.6)	20 (30.3)		79 (45.1)	159 (43.7)	21 (34.4)	
Often	64 (21.8)	98 (32)		54 (22.5)	86 (29.3)	22 (33.3)		32 (18.3)	117 (32.1)	13 (21.3)	
Always	8 (2.7)	51 (16.7)		16 (6.7)	27 (9.2)	16 (24.2)		10 (5.7)	31 (8.5)	18 (29.5)	
Breakfast consumption (%)											
<5	-	-	-	136 (56.7)	130 (44.2)	28 (42.4)	0.009	105 (60)	164 (45.1)	25 (41)	0.002
≥5	-	-		104 (43.3)	164 (55.8)	38 (57.6)		70 (40)	200 (54.9)	36 (59)	
Lunch intake time (min) (%)											
<10	136 (46.3)	104 (34)	0.009	-	-	-	-	109 (62.3)	120 (33)	11 (18)	<0.001
10-20	130 (44.2)	164 (53.6)		-	-	-		56 (32)	216 (59.3)	22 (36.1)	
>20	28 (9.5)	38 (12.4)		-	-	-		10 (5.7)	28 (7.7)	28 (45.9)	
Dinner intake time (min) (%)											
<10	169 (57.5)	124 (40.5)	<0.001	191 (79.6)	92 (31.3)	10 (15.2)	<0.001	111 (63.4)	165 (45.3)	17 (27.9)	<0.001
10-20	105 (35.7)	140 (45.8)		45 (18.8)	178 (60.5)	22 (33.3)		57 (32.6)	170 (46.7)	18 (29.5)	
>20	20 (6.8)	42 (13.7)		4 (1.7)	24 (8.2)	34 (51.5)		7 (4)	29 (8)	26 (42.6)	
Chewing efficiency (%)											
Not well	105 (35.7)	70 (22.9)	0.002	109 (45.4)	56 (19)	10 (15.2)	<0.001	-	-	-	-
Well	164 (55.8)	200 (65.4)		120 (50)	216 (73.5)	28 (42.4)		-	-	-	
Very well	25 (8.5)	36 (11.8)		11 (4.6)	22 (7.5)	28 (42.4)		-	-	-	
Intra-meal fluid intake (%)											
Never	48 (16.3)	29 (9.5)	0.09	31 (12.9)	36 (12.2)	10 (15.2)	<0.001	22 (12.6)	43 (11.8)	12 (19.7)	0.005
Sometimes	136 (46.3)	150 (49)		93 (38.8)	165 (56.1)	28 (42.4)		66 (37.7)	193 (53)	27 (44.3)	
Often	64 (21.8)	71 (23.2)		57 (23.8)	62 (21.1)	16 (24.2)		47 (26.9)	79 (21.7)	9 (14.8)	
Always	46 (15.6)	56 (18.3)		59 (24.6)	31 (10.5)	12 (18.2)		40 (22.9)	49 (13.5)	13 (21.3)	
Fried food (%)											
<5	203 (69)	211 (69)	0.9	174 (72.5)	206 (70.1)	34 (51.5)	0.004	122 (69.7)	259 (71.2)	33 (54.1)	0.02
≥5	91 (31)	95 (31)		66 (27.5)	88 (29.9)	32 (48.5)		53 (30.3)	105 (28.8)	28 (45.9)	
Spicy food (%)											
<5	184 (62.6)	154 (50.3)	0.002	138 (57.5)	162 (55.1)	38 (57.6)	0.8	91 (52)	215 (59.1)	32 (52.5)	0.2
≥5	110 (37.4)	152 (49.7)		102 (42.5)	132 (44.9)	28 (42.4)		84 (48)	149 (40.9)	29 (47.5)	

20 min) ate more daily and weekly snacks and breakfasts, respectively, and they also swallowed foods more regularly and consuming dinner more slowly, chewing meals better and had more intake of fried foods per week in addition of drinking fluids less often in comparison to subjects eating rapidly (<10 min). In terms of chewing efficiency and comparing within individuals consuming not well, those swallowing their foods very well used more daily snacks

and weekly breakfasts, eating more regularly and slowly, consuming more fried food and less intra-meal fluid. This table showed that persons with desired patterns of breakfast consumption, lunch intake time, and chewing efficiency had a more likelihood of being more regular with other aspects of eating habits.

The prevalence of FD, IBS, FC, and FDi in our study was 20%, 32.3%, 3%, and 53.2%, respectively. Participants suffering simultaneously from both FD-IBS, FD-FC, FD-FDi, and IBS-FDi consisted 11.3%, 0.8%, 16.3%, and 25% of population, respectively. There was no individual having both IBS-FC and FC-FDi concurrently. The relation between FGIDs' prevalence across different categories of dietary habits is provided in Figure 1. There was no significant relation in terms of FD and FC prevalence across different groups of breakfast consumption, lunch intake time, and chewing efficiency. Those consuming more breakfasts, eating slowly, and chewing their foods very well had a lower prevalence of IBS comparing to individuals in their first categories ($P = 0.005$, $P = 0.02$, and $P = 0.001$, respectively). With regard to FDi, the prevalence was significantly lower among participants eating breakfast at least 5 times weekly ($P = 0.002$) and chewing their meals very well ($P < 0.001$) compared to those with <5 breakfasts per week and chewing status of not well, respectively.

Multivariable-adjusted odds ratio (OR) for FD, IBS, FC, and FDi across multiple categories of desired dietary habits is depicted in Table 3. After adjustment of all proposed confounding variables, those who consumed at least 5 weekly breakfasts had statistically significant reduced risk (OR: 0.57, 95% confidence interval [CI] = 0.38–0.84) of having FDi in relation to reference group. In terms of lunch intake time and after all potential confounders adjustment, participants in consumption group of 10–20 min had an increased risk of 1.88 (95% CI = 1.08–3.27) and 1.75 (95% CI = 1.12–2.74) in getting FD and FDi, respectively, in comparison to lowest category. Those who took more than 20 min for lunch had a significant 56% (OR: 0.44, 95% CI = 0.23–0.85) and 67% (OR: 0.33, 95% CI = 0.13–0.84) risk reduction of having IBS in both crude and adjusted models, respectively, compared to participants in the category of the ones who spent <10 min for lunch. After adjustment of all potential confounding variables and based on chewing efficiency, those in the middle group (chewing well) compared to reference category had a 47% (OR: 0.53, 95% CI = 0.33–0.83), 76% (OR: 0.24, 95% CI = 0.06–0.89), and 48% (OR: 0.52, 95% CI = 0.34–0.79) reduced odds of having IBS, FC, and FDi, respectively. There was no significant relationship between highest and lowest categories of chewing efficiency in terms of any FGIDs in the last model.

Discussion

The aim of this present study was to evaluate the relation between certain dietary habits and major FGIDs among Iranian military crews. Our findings suggested that alteration in aforementioned eating patterns would be effective on the prevalence of FD, IBS, FC, and FDi. Since there are certain disciplines existing in military stations, manipulation of common feeding behaviors could be beneficial in decreasing symptoms and consequently their economic burden. To best of our knowledge, the current study was among the first population-based studies

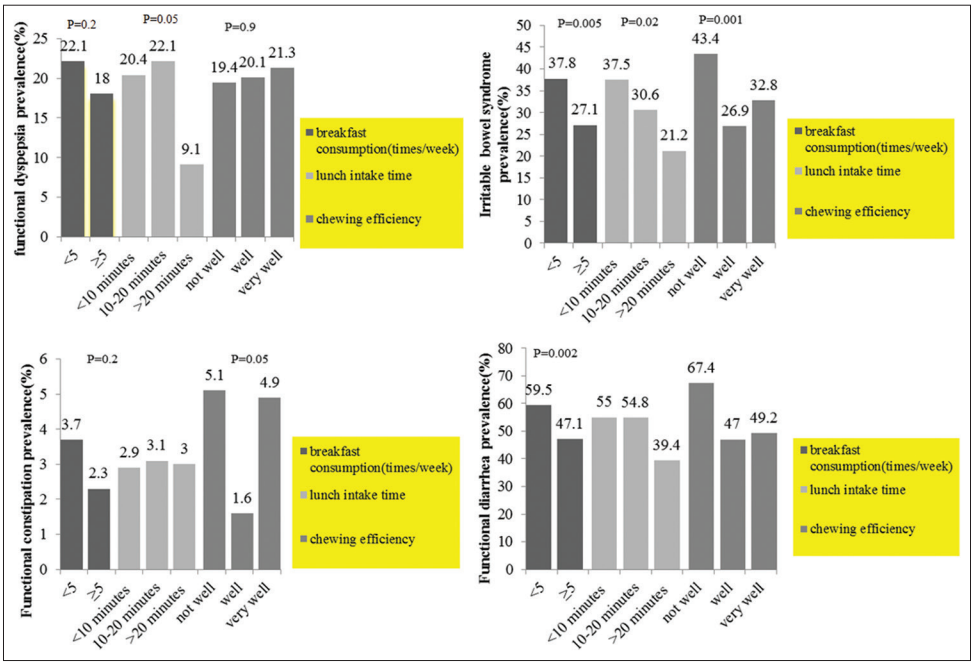

Figure 1: The prevalence of functional dyspepsia, irritable bowel syndrome, functional constipation, and functional diarrhea across different categories of breakfast consumption, lunch intake time, and chewing efficiency

Table 3: Multivariable adjusted odds ratios for functional dyspepsia, irritable bowel syndrome, functional constipation, and functional diarrhea across categories of breakfast consumption, lunch time, and chewing efficiency

	Breakfast consumption (times/week)			Lunch intake time				Chewing efficiency				
	<5	≥5	*P*	<10 min	10-20 min	*P*	>20 min	*P*	Not well	Well	*P*	Very well	*P*
FD													
Crude	1	0.77 (0.51-1.15)	0.2	1	1.10 (0.72-1.68)	0.6	0.39 (0.15-0.95)	0.03	1	1.04 (0.66-1.63)	0.8	1.12 (0.54-2.30)	0.7
Model 1	1	0.76 (0.50-1.14)	0.1	1	1.10 (0.73-1.68)	0.6	0.38 (0.15-0.93)	0.03	1	1.06 (0.67-1.67)	0.7	1.12 (0.55-2.31)	0.7
Model 2	1	0.76 (0.51-1.15)	0.2	1	1.10 (0.72-1.67)	0.6	0.35 (0.14-0.88)	0.02	1	1.05 (0.66-1.66)	0.8	1.10 (0.53-2.27)	0.7
Model 3	1	0.71 (0.46-1.08)	0.1	1	1.00 (0.65-1.54)	0.9	0.27 (0.10-0.73)	0.01	1	0.95 (0.59-1.52)	0.8	0.93 (0.43-2.00)	0.8
Model 4	1	0.87 (0.53-1.45)	0.6	1	1.88 (1.08-3.27)	0.02	0.32 (0.09-1.16)	0.08	1	1.10 (0.64-1.89)	0.7	1.79 (0.70-4.56)	0.2
IBS													
Crude	1	0.61 (0.43-0.86)	0.006	1	0.73 (0.51-1.05)	0.09	0.44 (0.23-0.85)	0.01	1	0.48 (0.32-0.70)	<0.001	0.63 (0.34-1.17)	0.1
Model 1	1	0.56 (0.39-0.80)	0.002	1	0.73 (0.50-1.06)	0.1	0.38 (0.19-0.75)	0.006	1	0.52 (0.35-0.76)	0.001	0.65 (0.34-1.21)	0.1
Model 2	1	0.56 (0.39-0.80)	0.002	1	0.73 (0.50-1.05)	0.09	0.36 (0.18-0.72)	0.004	1	0.51 (0.35-0.75)	0.001	0.64 (0.34-1.20)	0.1
Model 3	1	0.59 (0.41-0.85)	0.005	1	0.71 (0.49-1.04)	0.08	0.34 (0.17-0.70)	0.003	1	0.49 (0.33-0.73)	0.001	0.61 (0.32-1.18)	0.1
Model 4	1	0.66 (0.43-1.01)	0.05	1	0.90 (0.56-1.45)	0.6	0.33 (0.13-0.84)	0.02	1	0.53 (0.33-0.83)	0.006	1.08 (0.48-2.42)	0.8
FC													
Crude	1	0.60 (0.23-1.57)	0.3	1	1.05 (0.38-2.86)	0.9	1.04 (0.21-5.13)	0.9	1	0.30 (0.10-0.88)	0.02	0.95 (0.25-3.64)	0.9
Model 1	1	0.61 (0.23-1.61)	0.3	1	1.04 (0.38-2.85)	0.9	1.06 (0.21-5.25)	0.9	1	0.28 (0.10-0.83)	0.02	0.91 (0.23-3.52)	0.9
Model 2	1	0.59 (0.22-1.55)	0.2	1	1.04 (0.38-2.86)	0.9	1.23 (0.24-6.20)	0.8	1	0.29 (0.10-0.85)	0.02	0.98 (0.25-3.79)	0.9
Model 3	1	0.52 (0.19-1.39)	0.1	1	1.06 (0.38-2.92)	0.9	1.08 (0.20-5.63)	0.9	1	0.30 (0.10-0.88)	0.03	1.23 (0.30-4.96)	0.7
Model 4	1	0.61 (0.19-1.93)	0.4	1	2.66 (0.66-10.60)	0.1	3.24 (0.25-41.30)	0.3	1	0.24 (0.06-0.89)	0.03	0.87 (0.12-6.09)	0.8
FDi													
Crude	1	0.60 (0.43-0.83)	0.002	1	0.99 (0.70-1.39)	0.9	0.53 (0.30-0.92)	0.02	1	0.42 (0.29-0.62)	<0.001	0.46 (0.25-0.84)	0.01
Model 1	1	0.57 (0.41-0.79)	0.001	1	0.99 (0.7-1.40)	0.9	0.49 (0.28-0.87)	0.01	1	0.45 (0.30-0.66)	<0.001	0.47 (0.26-0.86)	0.01
Model 2	1	0.57 (0.41-0.80)	0.001	1	0.99 (0.70-1.40)	0.9	0.49 (0.28-0.87)	0.01	1	0.45 (0.30-0.66)	<0.001	0.47 (0.26-0.86)	0.01
Model 3	1	0.57 (0.41-0.80)	0.001	1	0.97 (0.68-1.37)	0.8	0.47 (0.26-0.86)	0.01	1	0.42 (0.29-0.62)	<0.001	0.41 (0.22-0.77)	0.006
Model 4	1	0.57 (0.38-0.84)	0.005	1	1.75 (1.12-2.74)	0.01	0.82 (0.37-1.81)	0.6	1	0.52 (0.34-0.79)	0.003	0.60 (0.28-1.25)	0.1

IBS: Irritable bowel syndrome, FD: Functional dyspepsia, FC: Functional constipation, FDi: Functional diarrhea

investigating dietary habits with FGIDs among military personnel.

The prevalence of FC in our study was 3%. This prevalence was in accordance with other studies which reported that its prevalence ranged from 1.9% to 27.2% and 1.4% to 37% worldwide and in Iran, respectively.[11,18] In FC diagnosis, the participant should not have any diagnostic criteria of IBS or FDi at the same time, but this issue was not proposed for FDi diagnosis. Furthermore, these studies are mostly performed on infectious diarrhea in general population and less is done on military personnel. Further studies required to define the range prevalence of this functional disorder.

Our findings showed that increasing lunch intake time was associated with decreased likelihood of FD, but this relation was not significant in the last model. This was concurrent with studies investigating this relation in which dyspeptic persons claimed to be fast eaters.[10,19,20] For instance, a cross-sectional study on 1978 Iranian individuals aged at least 35 years revealed an inverse relation between dyspepsia and duration of meal intake.[10] This association might be explained by the fact that eating fast may lead to cause stomach fullness and discomfort due to improper swallowing. Furthermore, another study demonstrated that among 89 female cadets studying at the Armed Force Academy of Korean Republic Army, significant percentage of participants suffering from dyspepsia ate their meals within 13 min compared to control group.[20] Their small sample size (11 participants with dyspepsia) must be kept in mind for interpretations of data. Eating time is a variable which might be influenced by other factors including appetite, type of food, cultural differences, and the size portion of consumed meal.[20] Since one model was just significantly showed a linear relation, several comprehensive researches needed to be done clarifying the exact relation. The present study suggested that weekly breakfast consumption was not related with FD prevalence. This was in agreement with Xu *et al*.'s study in which 203 out of 1304 participants were diagnosed as having FD. Although dyspeptic participants missed their breakfast more often than control ones, the odds of skipping breakfast in the occurrence of FD was not statistically significant (OR: 1.70, 95% CI = 0.97–2.97).[21]

Participants in our study eating meals slowly and chewing them better had lower percentage of IBS, but this relation was not significant in terms of breakfast consumption. Another study was similar to our findings indicating that among 193 participants, eating in a hurry fashion based on subjective perception was more prevalent in IBS patients compared with non-IBS ones (41.7% vs. 22%, $P < 0.05$).[22] On the other hand, a cross-sectional study on 78 IBS individuals and 79 healthy ones in China could not reveal a significant association between food intake time and IBS prevalence.[23] Their small sample size might be a potential factor influencing the results. Based on chewing efficiency and prevalence of IBS, an Iranian population-based study showed similar results as ours, in which 988 adolescent girls aged 12–18 years were recruited and asked to estimate chewing ability through a three-item scale (no problem, just soft and pasty foods, or no food). The diagnosis of IBS was made by Rome III criteria. The results showed that individuals lacking of chewing ability appropriately had a significantly greater prevalence of IBS.[24] Several pathophysiological mechanisms have been postulated explaining this finding. Improper chewing might lead to inadequate food exposure to saliva which consequently could lead to incomplete acid secretion and bolus formation. Furthermore, scant chewing could be associated with autonomous nervous system dysfunction leading to impaired gastric motor function.[24,25] Breakfast consumption was negatively associated with IBS prevalence, but in the last model and after adjustment of all potential confounders, the relation became weakly significant ($P = 0.05$). Chirila *et al*. suggested that among 193 individuals with a mean age of 50.8 ± 16.2 years, there was no significant association in terms of daily breakfast consumption and IBS prevalence.[22] Furthermore, Khayyatzadeh *et al*.'s study showed that there was no significant odds of relationship between any categories of breakfast intake (never or 1, 2–4, 5–6, and every day) and prevalence of IBS in both crude and adjusted models.[24] Although a cross-sectional population-based study in Singapore showed a direct relation in terms of skipping breakfast and IBS, this association was not statistically significant in adjusted models.[26] In contrast, internet survey on Japanese population lifestyle demonstrated that the percentage of skipped meals was more common in IBS patients rather than control group, especially in terms of breakfast eating.[27] Further studies required to evaluate the exact relation and etiological connection between these two variables.

None of our findings were significant between the relation of dietary habits and FC except in terms of chewing insufficiency showing an inverse relation. One possible mechanism could be the point that by chewing foods properly, gastric and bowel motility under the influence of autonomic nervous system might be accomplished correctly, and therefore, FC symptoms and prevalence might be declined. Breakfast consumption was failed to demonstrate any influences on FC prevalence. With respect to our results, Ohlsson and Manjer study on 16,840 individuals aged 45–75 years did not reveal any relation between breakfast consumption and FC prevalence.[28] In this present study, its prevalence was lower than average and deductions must be performed cautiously, and further population-based studies are necessary confirming exact relation.

The current study revealed that individuals consuming more weekly breakfasts, ate lunch slowly, and chewed better

had a lower prevalence of FDi. Breakfast intake results were against a study performed on participants aged at least 45 years in which it was demonstrated that breakfast consumption was not associated with FDi prevalence.[28] Eating slowly and chewing well may result in proper GI tract function leading to normal defecation frequency and consistency, but multiple studies needed clarifying the accurate connection.

This study was the first in literature assessing the association between dietary habits and major FGIDs among military personnel. Quite good sample size was another strength. Our current study was not free of limitations. The major one was the design of research which was not able to confirm the exact cause and effect relationship. Furthermore, the absence of taking information about drug usages or psychological issues must be taken into account while generalization of results to other nations.

Conclusions

Our findings suggested that changing in dietary habits including breakfast consumption, lunch intake time, and chewing efficiency among army personnel would be effective to decrease FGIDs' prevalence and to increase their quality of lives and functional capability. Further prospective studies required to evaluate the etiological and exact pathophysiological mechanisms between the aforementioned variables.

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Conflicts of interest

There are no conflicts of interest.

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