Association between Dietary Fat Intake and Odds of Gastro-esophageal Reflux Disorder (GERD) in Iranian Adults

Abstract

Background: Most information on the association of dietary fat intake and gastro-esophageal reflux disorder (GERD) came from developed countries, where lifestyle and other dietary components might be different from those in developing countries. This cross-sectional study was, therefore, conducted to investigate the association between dietary fat intake and odds of having GERD in a large group of Iranian population. **Study Design:** This cross-sectional study was done among 3362 adult population in Isfahan, Iran. Dietary intakes were collected by the use of a validated semi-quantitative food frequency questionnaire. **Methods:** Assessment of GERD was done using a validated self-administered questionnaire examining the frequency of heartburn in the last 3 months. Individuals with the presence of heartburn symptoms sometimes, often or always during the last 3 months were defined as having GERD. **Results:** Participants in the top category of dietary fat intake had higher daily intakes of energy, macronutrients and micronutrients. Dietary intakes of all food groups were also significantly higher among those in the top quintile as compared with those in the bottom category of dietary fat intake ($P < 0.001$ for all). There were no significant associations between dietary fat intake and incidence of GERD in general population. Crude and multivariable-adjusted models revealed no significant associations between dietary fat intake and having GERD in either gender. **Conclusions:** We found no significant association between dietary fat intake and odds of having GERD in this population. Further studies, in particular of prospective designs, are warranted to clarify this association.

Keywords: *Cross-sectional studies, dietary fats, gastroesophageal reflux*

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Introduction

Gastro-esophageal reflux disease (GERD) is one of the most common chronic upper gastro-intestinal tract diseases[1] that exhibits large range of typical and atypical symptoms such as heartburn (a burning feeling behind the breast bone), regurgitation of acid of the gastro-duodenal into the esophagus, non-cardiac chest pain, chronic cough and hoarseness.[1-3] It affects up to 1520% of adult population. The prevalence in Iranian adult population has been reported to be 21.2%.[1-3] Individuals with GERD are at greater risk of dysphagia, esophagus ulcer, upper gastro-intestinal (GI) tract bleeding, stricture formation, Barrett's esophagus and metaplasia of the distal esophageal mucosa.[3,4] Despite the considerable knowledge on GERD pathogenesis, its risk factors remain poorly understood.[5] It seems that dietary intakes might also get involved in the prevalence and incidence of GERD symptoms.[2] Patients with GERD are usually advised to avoid fatty foods because GERD episodes were increased after eating fatty foods.[6] However, data in this regard are conflicting. Several experimental and clinical studies revealed that consumption of high fat foods decreased the lower esophagus sphincter (LES) pressure and increased the esophageal acid exposure.[7,8] Findings from observational studies have indicated that subjects with the highest fat intake had a greater risk of reflux esophagitis and functional dyspepsia compared with those with the lowest intake.[9,10] Others have also reported a positive association between high dietary fat intake and increased risk of GERD symptoms.[2,11] However, data from National Health and Nutrition Examination Survey demonstrated that increased fat intake was not associated with greater odds of GERD.[5,6,12] On the basis of national data, of the total of energy intake, 22% came from fats.[13] Previous studies have mostly focused on frequency of fried foods intake and high fat meals, not total dietary fat intake.[14]

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Most information on the association of dietary fat intake and GERD came from developed countries, where lifestyle and other dietary components might be different from those in developing countries. In addition, almost all earlier investigations have been limited in sample size and have not considered the potential confounders. Given the inconsistencies in previous findings, it seems that additional data from large studies, controlling for a wide range of confounders, are required to shed light on this issue. This cross-sectional study was, therefore, conducted to investigate the association between dietary fat intake and odds of having GERD in a large group of Iranian population.

Methods

Study population

This cross-sectional study was undertaken within the "Study on the Epidemiology of Psychological, Alimentary Health and Nutrition" (SEPAHAN) project. The main aim of SEPAHAN was to investigate the association between lifestyle-related factors and functional gastrointestinal disorders. Information about study design, sampling method, data collection and participants' characteristics are described in detail elsewhere.[15] In short, participants were recruited from the general population of Isfahan province, who were working in health centers affiliated with Isfahan University of Medical Sciences (IUMS). Data collection process of SEPAHAN project was conducted in two separate phases during April 2010 to May 2010. In the first phase, 10,087 self-administered questionnaires, containing information on demographics and dietary data, were distributed and 8,691 subjects responded (response rate: 86.16%) to the questions. In the second phase, information on gastrointestinal function was collected through sending the relevant questionnaires to 9,652 participants enrolled in the first phase and 6,239 questionnaires were completed and returned (response rate: 64.6%). No significant difference was seen in the demographic data of those returned the questionnaires and those that did not. In the current study, we excluded individuals with under- and over-reporting of energy intake (800–4200 kcal/day). We also excluded individuals who had missing data on dependent and independent variables, as well as on confounding factors. After these exclusions, data from 3362 participants remained for the current study. We obtained written informed consent from all subjects. The study was approved by the Regional Bioethics Committee of IUMS (nos. #189069, #189082, and #189086).

Assessment of dietary fat intake

Dietary data on fat intake were obtained using a validated Willett-format dish-based semi-quantitative food frequency questionnaire (DS-FFQ) including 106 items. This questionnaire was originally designed and validated specifically for Iranian adults.[16] Detailed information about the development of the questionnaire, its foods list and frequency response categories as well as its validity was published previously.[16,17] The questionnaire consisted of five main categories of foods and dishes: (1) mixed dishes (cooked or canned, 29 items); (2) grains (different types of bread, cakes, biscuits and potato, 10 items); (3) dairy products (dairies, butter, and cream, 9 items); (4) fruits and vegetables (22 items); and (5) miscellaneous food items and beverages (including sweets, fast foods, nuts, desserts, and beverages, 36 items).

Daily intake of fat for each participant was calculated using the US Department of Agriculture's (USDA) national nutrient databank.[18] In the current analysis were used total saturated fatty acids (SFAs), total monounsaturated fatty acids (MUFAs), total polyunsaturated fatty acids (PUFAs), total trans fatty acids (TFAs) and cholesterol.

Assessment of gastro-esophageal reflux disorder (GERD)

In the current study, a validated self-administered questionnaire (validated ROME III questionnaire), assessing the frequency of heartburn in the last 3 months, was used.[15] The questionnaire included the rating scale of never or rarely, sometimes, often, always. In addition, the severity of heartburn was asked as follow: mild, moderate, severe, and very severe. GERD was defined as the presence of heartburn symptoms sometimes, often or always during the last 3 months prior to meeting in the study.

Assessment of other variables

Demographic and anthropometric information age, gender, weight, and height were achieved self-administered questionnaires. Physical activity status was assessed by General Practice Physical Activity Questionnaire (GPPAQ). The levels of physical activity were categorized as doing exercise at never, <1 h/wk, 13 h/wk or >3 h/wk. Consequent self reported data collection; we categorized participants as non-smokers, ex-smokers or current smokers. The meal regularity was asked as never, sometimes, often or always. The eating rate was specified following question was asked: "how long does it take you to eat lunch or dinner?" and their answers including one of these subjects: I never eat lunch, <10 min, 1020 min, or >20 min. If the duration of the having lunch time was less than 10 minutes, it defined as rapid food eaters. We evaluated the frequency of breakfast consumption by following questions: "never or one day/wk, 24 days/wk, 56 days/wk or every day". Breakfast skipping was characterized as eating breakfast never or one day per week. Meal-to-sleep interval was questioned as: "how long does it take you to go to sleep (or to lie down) after lunch (never sleep or lie down, <30 min, 0.5 <2 h, 24 h, >4 h)", and after dinner (<30 min, 0.5 <2 h, 24 h, >4 h). Tea drinking pattern was assessed by using the pre-tested questionnaire. The frequency of tea consumption were include "never or less than 1 cup/month, 13 cups/month, 13 cups/wk, 46 cups/wk, 1 cup/day, 24 cups/day, 57 cups/day, 811 cups/day or at least 12 cups/day". Similarly the

status of coffee drinking and chocolate consumption were also evaluated through a self-administered questionnaire. Coffee drinking and chocolate consumption patterns were classified as never or less than 1 cup/month, 13 cups/month, 1 cups/wk, 24 cups/wk, 56 cups/wk, 1 cup/day, 23 cups/day, 45 cups/day, at least 6 cups/day), soft drink (never or less than 1 cup/month, 13 cups/month, 1 cups/wk, 24 cups/wk, 56 cups/wk, 1 cup/day, 23 cups/day, 45 cups/day; and never or less than once/month, 1–3 times/month, 1 times/wk, 2–4 times/wk, 56 times/wk, 12 times/day, 35 times/day, 69 times/day, at least 10 times/day; respectively.

Statistical analysis

Analyses were done separately by gender. First, participants were categorized based on quintiles of dietary fat intake. One-way analysis of variance was used to examine significant differences in continuous variables across quintiles of dietary fat intake. The distribution of participants in terms of categorical variables across quintiles was assessed by means of Chi-square test. Age and energy-adjusted intakes of foods and nutrients across quintiles of dietary fat intake were examined using analysis of covariance. To find the association between dietary fat intake and GERD, we used logistic regression in different models. First, Crude model was done without any adjustments. In adjusted model I, we controlled for age (continuous) and total calorie intake (continuous). Then we further controlled for physical activity (categorical), smoking (yes/no), diabetes (yes/no), supplement use (yes/no) and aspirin (yes/no). Additional adjustment was done for meal regularity (categorical), eating rate (categorical), chewing quality (categorical), intra-meal fluid intake (categorical), and after-meal lying down (categorical). In an additional model, we considered consumption of coffee, tea and, chocolate. Then in the final model, we took into account body mass index (BMI) to find if the associations were obesity independent. In all analyses, the first quintile of dietary fat intake was considered as a reference. To assess the overall trend of odds ratios across increasing quintiles of dietary fat intake, we treated the quintile categories as an ordinal variable in the analyses. All analyses were performed using SPSS software (version 19.0; SPSS Inc, Chicago IL). *P* values were considered significant at <0.05.

Table 1: General characteristics and diet-related practices participants across quintiles of dietary fat intake

	Men			*P*	Women			*P*
	Quintiles of dietary fat intake				Quintiles of dietary fat intake			
	Q1 (*n*=228) <69.6	Q3 (*n*=284) 89.7109.6	Q5 (*n*=332) >134.5		Q1 (*n*=444) <63.0	Q3 (*n*=388) 81.2100.8	Q5 (*n*=340) >126.2	
Age (year)	38.0±7.9*	38.8±7.7	39.3±8.7	0.26	35.9±7.4	34.7±7.4	34.3±7.3	0.008
Weight (kg)	76.8±13.2	77.8±12.3	75.5±13.0	0.25	63.9±11.1	62.7±10.3	62.5±10.4	0.14
BMI (kg/m^2)	25.5±3.6	25.8±3.3	24.9±3.5	0.02	25.0±4.2	24.4±3.9	24.3±4.2	0.05
Married (%)	91.2	91.3	86.5	0.37	77.7	72.8	72.7	0.38
Self-reported diabetes (%)	2.9	2.1	2.9	0.54	1.5	1	1.3	0.63
University graduated (%)	51.8	50.2	52.5	0.92	60.9	74.5	70.9	0.001
House owner (%)	57.5	59.4	60.7	0.83	56.3	57.9	62	0.83
Hypertension (%)	5.4	5.3	3.9	0.88	3.1	2.8	4.3	0.29
Colitis or Crohn's disease (%)	1.1	2.1	2.1	0.81	0.8	1	0.3	0.60
Gallbladder stone (%)	0	0.7	0.4	0.67	1.5	1.8	2.8	0.06
Stroke (%)	0	0	0	0.09	0.5	0.3	0.3	0.47
Myocardial infarction (%)	0.7	0.7	0.4	0.93	0	0	0	0.40
Heart failure (%)	1.4	1.8	2.5	0.19	1	0.8	0.3	0.01
Doing exercise ≥1 h/w (%)	20.4	20.6	23.9	0.18	5.6	6.9	8.4	0.60
Supplement use (%)	10.4	11.7	10	0.22	44.2	43.1	41.8	0.77
Chewing quality (%)				0.79				0.13
Usual	13.3	12.7	14.5		17.6	12.6	11.3	
Well	74.8	74.3	69.8		70.9	73.5	76.7	
Very well	11.9	13	15.6		11.5	13.9	12.1	
Intra-meal fluid intake (%)	31.1	33.1	32.9	0.97	17.4	23.2	25.5	0.02
Lying down After meal (%)	34.6	28.1	29.3	0.37	34.3	30.6	35.2	0.64
Smoking status (%)				0.06				0.75
Never	80	78.6	71.8		85.7	87.8	86	
Former	6.8	6.8	11.4		0	0	0	
Current	13.2	14.6	16.8		14.3	12.2	14	
Aspirin use (%)	8.9	6.8	12.1		4.9	4.6	4.3	0.75

*All values are means±SD unless indicated

Table 2: Dietary intakes of study participants across quintiles of dietary fat intake

	Men			*P*	Women			*P*
	Quintiles of dietary fat intake				Quintiles of dietary fat intake			
	Q1 (*n*=228) <69.6	Q3 (*n*=284) 89.7109.6	Q5 (*n*=332) >134.5		Q1 (*n*=444) <63.0	Q3 (*n*=388) 81.2100.8	Q5 (*n*=340) >126.2	
Total energy (kcal/day)	1440±410	2520±515	3437±433	<0.001	1329±328	2269±408	3340±454	<0.001
Carbohydrates (g/day)	190±80	320±113	375±83	<0.001	179±63	290±90	386±91	<0.001
Proteins (g/day)	51±15	93±19	136±23	<0.001	47±13	82±16	124±23	<0.001
Saturated fats (g/day)	14±4	24±4	37±7	<0.001	12±3	22±4	34±7	<0.001
Monounsaturated fats (g/day)	21±5	39±4	63±9	<0.001	19±4	35±3	59±8	<0.001
Polyunsaturated fats (g/day)	16±4	29±4	46±8	<0.001	14±4	26±4	44±9	<0.001
Cholesterol (mg/day)	152±64	259±85	439±116	<0.001	132±50	230±69	363±105	<0.001
Total fiber (g/day)	14±6	23±8	30±8	<0.001	14±6	23±8	30±8	<0.001
Vitamin A (µg/day)	340±165	495±181	770±234	<0.001	314±143	500±180	742±291	<0.001
Vitamin C (mg/day)	69±42	93±52	127±54	<0.001	74±48	109±54	139±66	<0.001
Vitamin E (mg/day)	12±3	21±4	34±7	<0.001	11. ± 3	20±4	32±7	<0.001
Folate (mg/day)	167±123	307±196	299±140	<0.001	149±93	246±139	297±166	<0.001
Iron (mg/day)	11±5	19±7	24±5	<0.001	10±4	17±5	23±5	<0.001
Potassium (mg/day)	2115±677	3339±836	4750±988	<0.001	2043±691	3287±842	4709±999	<0.001
Calcium (mg/day)	667±438	1104±628	1216±516	<0.001	587±343	964±494	1199±466	<0.001
Food groups								
Fruits (g/day)	212±182	276±226	345±191	<0.001	260±204	379±258	424±272	<0.001
Vegetables (g/day)	162±95	224±94	328±145	<0.001	155±107	229±108	335±153	<0.001
White meat (g/day)	30±22	61±40	121±66	<0.001	31±23	56±33	97±56	<0.001
Red meat (g/day)	39±21	80±33	143±53	<0.001	33±18	69±27	129±53	<0.001
Low fat dairy (g/day)	247±210	339±248	401±315	<0.001	223±191	341±267	412±285	<0.001
High fat dairy (g/day)	10±15	14±13	23±25	<0.001	8±11	15±17	23±23	<0.001
Refined grains (g/day)	254±150	456±248	491±196	<0.001	235±129	372±187	492±216	<0.001
Whole grains (g/day)	24±53	49±94	55±79	<0.001	22±47	46±80	52±84	<0.001
Tea + coffee (g/day)	338±283	389±305	495±357	<0.001	307±270	347±231	374±265	<0.001

Table 3: Odds ratios and 95% confidence intervals for having GERD across quintiles of dietary fat intake

	Men			*P*-trend	Women			*P*-trend
	Quintiles of dietary fat intake				Quintiles of dietary fat intake			
	Q1 <69.6	Q3 89.7109.6	Q5 >134.5		Q1 <63.0	Q3 81.2100.8	Q5 >126.2	
n	228	284	332		444	388	340	
Total dietary fat								
Crude	1.00	0.85 (0.56-1.29)	1.34 (0.91-1.98)	0.44	1.00	0.88 (0.65-1.29)	0.79 (0.57-1.1)	0.33
Model I	1.00	0.94 (0.54-1.64)	1.40 (0.68-2.90)	0.61	1.00	1.18 (0.78-1.79)	1.32 (0.71-2.47)	0.25
Model II	1.00	0.76 (0.40-1.43)	1.54 (0.66-3.58)	0.62	1.00	1.29 (0.82-2.05)	1.24 (0.62-2.49)	0.51
n	280	281	280		391	392	392	
Saturated fatty acids								
Crude	1.00	0.97 (0.65-1.45)	1.28 (0.87-1.88)	0.36	1.00	0.87 (0.63-1.18)	0.70 (0.50-0.96)	0.09
Model I	1.00	1.21 (0.73-2.02)	1.34 (0.71-2.53)	0.68	1.00	0.93 (0.64-1.36)	0.81 (0.48-1.36)	0.61
Model II	1.00	1.26 (0.68-2.32)	1.93 (0.90-4.15)	0.16	1.00	1.16 (0.73-1.83)	0.88 (0.47-1.65)	0.86
Mono-unsaturated fatty acids								
Crude	1.00	0.89 (0.59-1.35)	1.30 (0.87-1.92)	0.36	1.00	0.80 (0.58-1.11)	0.78 (0.56-1.08)	0.19
Model I	1.00	1.02 (0.60-1.73)	1.44 (0.75-2.80)	0.36	1.00	0.95 (0.64-1.42)	1.03 (0.58-1.84)	0.78
Model II	1.00	0.83 (0.43-1.62)	1.68 (0.61-4.58)	0.31	1.00	1.05 (0.64-1.70)	1.09 (0.50-2.41)	0.89
Poly-unsaturated fatty acids								
Crude	1.00	0.72 (0.48-1.08)	1.00 (0.68-1.48)	0.71	1.00	0.91 (0.67-1.28)	0.94 (0.68-1.30)	0.59
Model I	1.00	0.63 (0.36-1.10)	0.71 (0.35-1.48)	0.24	1.00	1.18 (0.79-1.77)	1.67 (0.94-2.98)	0.10
Model II	1.00	0.40 (0.20-0.82)	0.34 (0.11-1.08)	0.02	1.00	1.28 (0.78-2.12)	2.04 (0.89-4.71)	0.21

Model I: Adjusted for age, total calorie intake. Model II: Further controlled for physical activity, smoking, diabetes, supplement use, aspirin, meal regularity, eating rate, chewing quality, intra-meal fluid intake, after meal lying down, coffee, tea, chocolate, vitamin E, BMI.

Results

General characteristics of study participants across categories of dietary fat intake are shown in Table 1. Females in highest quintile of dietary fat intake had higher BMI, were more likely to be younger, university graduated and greater percent of them had intra-meal fluid intake than those in the lowest quintile. Men in the top quintile of dietary fat intake had greater BMI. There was no significant difference in the distribution of men and women across quintile of dietary fat intake in terms of marital status, house owner, suffering from chronic conditions, doing exercise, supplement use, chewing quality, smoking status and aspirin use.

Dietary intakes of participants across categories of dietary fat intake are provided in Table 2. Participants, both males and females, in the top category of dietary fat intake had higher daily intakes of energy, macronutrients, saturated fats, monounsaturated fats, polyunsaturated fats, cholesterol and fiber, and micronutrients. Dietary intakes of all food groups including fruits, vegetables, white meat, red meat, low and high-fat dairy products, refined grains, whole grains and tea or coffee were also significantly higher among those in the top quintile as compared with those in the bottom category of dietary fat intake ($P < 0.001$ for all).

Crude and multivariable-adjusted odds ratios and 95% class intervals (CIs) for having GERD across categories of dietary fat intake are indicated in Table 3. No significant associations were seen between dietary fat intake and incidence of GERD in either gender either before or after controlling for several potential confounders, including diet-related practices.

Discussion

The present cross-sectional study examined the association between dietary fat intake and risk of GERD in Iranian adult population. After controling for a wide range of potential confounders including diet-related practices, we found no significant association between dietary fat intake and prevalence of GERD either in men or women. This study is the first from the Middle Eastern population that assessed dietary fat intake in relation to GERD. To our knowledge, this study is among the first investigations in which diet-related habits have been taken into account when assessing dietary intakes in relation to upper gastrointestinal disorders.

GERD is one of most frequent gastrointestinal problems in both developed and developing countries.[11] We found no significant association between dietary fat intake and prevalence of GERD in men or women. In line with ours, some other investigators found no relationship between dietary fat intake and risk of GERD.[5,6,12] Fox *et al.* indicated no significant difference in reflux symptoms in patients with typical reflux disorder comparing those who consumed high-fat and low-fat diets.[5] Furthermore, it has been demonstrated that consumption of a high fat meal did not increase the rate of reflux episodes in patients with esophageal reflux compared to control subjects.[12] In contrast, some evidence from experimental and clinical studies suggested that reduced dietary fat intake might lower the risk of GERD.[2,7,9,10] For instance, El-Serag *et al.* reported that high dietary fat intake was associated with increased risk of GERD and erosive esophagitis; however, when they adjusted for BMI, the significant association disappeared. In addition, high saturated fat and cholesterol intake was linked to GERD only in participants with a BMI >25 kg/m^2, not among those with a normal BMI.[2] Also in a case-control study, higher risk of reflux esophagitis were seen among patients in the highest quartile of total dietary fat intake compared to those in the lowest quartile.[9] These controversial findings might be attributed to differences in the study design, and subjects' characteristics. In addition, earlier studies have not controlled for a wide range of confounders including dietary habits, BMI, tea and coffee intake and smoking. These variables were taken into account in the current analysis.

Several points need to be considered in the interpretation of our findings. In this analysis, we did not consider the patient's status with regard to history of hiatal hernia. Diagnosis of GERD by subjective questionnaire was a limitation which might affect our findings. However, previous studies were used this scale.[15] The most important limitation of this study was its cross-sectional design which would not help us to confer causality. Dietary assessment of fat intake in the current study was done by the use of FFQ, which would in turn lead to misclassification of participants in terms of dietary fat intake. However, this sort of bias is unlikely to affect the findings. Moreover, despite adjusting for a wide range of confounders including diet-related practices in the current study, there might be other factors including types of dietary fat among Iranian population, depression, stress and anxiety that might further confound the association. Therefore, residual confounding cannot be excluded. Large study population and controlling for major confounders including BMI are among several strengths of this study.

In conclusion, we did not find evidence indicating the association between dietary fat intakes and risk of GERD in this cross-sectional study. Further studies, in particular of prospective designs, are required to clarify this association.

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