Is Dietary Pattern Associated with Gastric Cancer Risk? A Case-control Study in Iran

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Research note

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Abstract

Objective

Diet is considered an important contributor to cancers and one of the best approaches for assessing the combined effect of nutrients and food is the dietary pattern approach. In the present study, the association of dietary patterns identified by factor analysis with gastric cancer risk was studied.

Results

Four major dietary patterns with a 55.48% prediction rate, namely “tubers and spices”, “cereals and dairies”, “healthy” and “Western-style”, were identified. Tubers and spices (males: 11.42 (4.17, 26.75); females: 6.94 (2.24, 21.56)) and “Western-style” dietary patterns (males: 1.16 (1.00-4.35); females: 2.25 (1.10, 6.49) significantly increased the odds of gastric cancer risk in both sex. However, “healthy” dietary pattern and “cereals and dairies” dietary pattern were not associated with gastric cancer risk ($P > 0.05$).

Introduction

Gastric cancer (GC) is one of the most important leading causes of death worldwide and it affects the patient’s quality of life and health [1]. Considering the high mortality rate of gastric cancer, primary prevention is an important approach for the improvement of gastric prognosis [2]. Many factors including genetic predisposition, lifestyle, and environmental factors are considered as risk factors of gastric cancer [3]. Diet is also considered as one of the important contributors to cancers [4] and many attempts have been made to identify the important food and nutrients associated with gastric cancer. However, nutrients or foods are not consumed isolated and the etiology of cancers could not be explained only by assessment of a single nutrient or food [5]. One of the approaches for assessment of the combined effect of nutrients and food is the dietary pattern approach [6, 7]. Using this approach, the complete picture of food and nutrient interactions and their synergic effects could be achieved and the link between diet and chronic disease could be evaluated [8].

Previously, the association between dietary pattern and gastric cancer risk has been investigated in some studies and provided mixed results in different populations. In Uruguay, De Stefani et al showed that starchy food pattern was significantly associated with gastric cancer risk and the healthy dietary pattern has a negative association with gastric cancer risk [9]. In another case-control study in Canada, it was indicated that Western dietary patterns were increased the odds of stomach cancer, however, healthy dietary patterns were associated with decreased risk [10]. In another study in Japan, the traditional Japanese dietary pattern was associated with an increased risk of gastric cancer, however, the western dietary pattern did not associate with gastric cancer risk [11]. Moreover, the results of a meta-analysis that included the results of studies conducted in European countries, the united states and japan showed about the 2-fold difference in gastric cancer risk between a ‘healthy’ dietary pattern and Western dietary

pattern [12]. Although, previously the association of different food items and gastric cancer risks was studied in the Iranian population [13], to the best of our knowledge, the relationship between dietary pattern and gastric cancer was not studied. The prevalence of gastric cancer in the northwest of Iran is high and Iran recently faced with nutrition transition namely the adoption of a Western diet, and its combination with traditional dietary patterns provides a particular occasion for further studies in the field of dietary pattern [14]. So, in the current study, the association of dietary patterns identified by factor analysis with gastric cancer risk was studied.

Materials And Methods

In the present hospital-based case-control study, cases and controls were selected from the four major and reference hospitals located in Tabriz-Iran between May 2009 and May 2011. The Ethics Committee of Tabriz University of Medical Sciences approved the present study and the written informed consent was obtained from all participants.

Cases recruitment

The cases were newly diagnosed patients who had histologically confirmed cancer of stomach without other cancers, or any other diseases that affect the dietary pattern, lived in East Azerbaijan province for more than twenty years, and aged between 20–85 years. They were recruited from two major hospitals in Tabriz, Iran. These hospitals are the reference hospitals in cancer in the region. A total of 192 cases were identified. The participation fraction was 90.56% for cases. There were no significant differences in age, sex, marital status, educational level, and BMI between responders and nonresponses.

Controls recruitment

Two controls were randomly selected for each case from orthopedic and ophthalmic wards of two other hospitals in Tabriz which are the reference hospitals for orthopedic (Shohada hospital) and ophthalmic (Alavi hospitals) disorders in the region. The controls were excluded if they reported the history of cancer or any other diseases that affect dietary patterns such as diabetes or cardiovascular diseases, family history of common cancers; and gastrointestinal disorders. Totally, 365 individuals were selected as a control group. The participation fraction was 90.34% for controls. There was no significant differences in age, sex, marital status, educational level and BMI between responders and nonresponses.

Data collection

Covariates for multivariate regression analyses included age, body mass index (BMI), education, marital status, smoking status (over the past year), alcohol consumption (over the past year), self-reported history of H.Pylori infection, number of meals/day, the habit of drinking or eating hot tea and foods. The

trained nurses in each hospital gathered information about the dietary and demographic and previous diseases. The demographic information included age, alcohol, and smoking status. For BMI calculation, the body-weight was measured to the nearest 0.1 kg on a Seca digital weighing scale (Dubai, United Arab Emirates), and height was measured to the nearest 0.1 cm, with bare feet using a stadiometer fixed to the wall and BMI was calculated by dividing weight (kg) to height^2 (m^2). Waist circumference was measured at the minimum circumference between the iliac crest and the rib cage.

For food pattern determination, a 100-item qualitative food frequency questionnaire (FFQ), asking about the consumption of food and beverages over the past year in the control group and over the past year before diagnosis in the case group was used. This questionnaire was completed by face-to-face personal interviews. Each food item was assigned to one of the defined food groups according to their nutrient content (Table S1).

Statistical analysis

For statistical analyses, SPSS V18 was used. Factor analysis with principal component extraction method and Varimax rotation was used to determine major dietary patterns. Food groups that had commonalities > 0.20 were considered. The derived dietary patterns were labeled considering the food group that had high positive loading and also considering the prior literature. The factor score was calculated and for each dietary pattern, participants received a factor score. Participants were categorized according to tertiles of dietary pattern scores. The between-groups comparisons for continuous and categorical variables were determined using independent sample t-test and chi-square test respectively. The stepwise forward Logistic regression was used to determine the association between dietary patterns and gastric cancer (criteria for entry and retain in the model: $p \leq 0.05$ and $p \leq 0.20$, respectively). The covariate candidates for inclusion were those statistically significant in univariate analyses ($p < 0.15$) (age, education, marital status, BMI, smoking, and history of H.Pylori infection and hot teat drinking and hot food eating habit).

Results And Discussion

Using the factor analysis method, four major dietary patterns were identified (Table 1). The first pattern accounted for 19.35% of the variance, loaded positively for tubers, spices, vegetables, salt, oil, eggs and legumes, labeled tubers, and spices. The second pattern (named cereals and dairies), accounted for 13.25% of the total variance, which was characterized by a high intake of cereals and dairy products. Considering the positive load of nut and dry fruits and fruits on the third dietary pattern, this pattern labeled healthy patterns. This pattern accounted for 12.53% of the total variance. Finally, the last extracted pattern accounted for 1.33% of the variance, was characterized by high consumption of high energy drinks, processed foods and snacks, and desserts, and labeled “Western-style” dietary pattern. Totally, these patterns explained 55.48% of the total variance in dietary patterns.

Table 1
Factor-loading matrix for major dietary patterns

Food groups	Tuber and spices	Cereals and dairies	Healthy	Western-style
Tuber	0.69	-	-	-
Spices	0.66	-	-	-
Vegetables	0.65	-	-	-
Oil	0.63	-	-	-
salt	0.57	-	-	-
Egg	0.55	-	-	-
Legumes	0.47	-	-	-
cereals	-	0.96	-	-
Dairy products	-	0.96	-	-
Nuts and dry fruits	-	-	0.77	-
fruits	-	-	0.56	-
High energy drinks	-	-	-	0.76
Processed meats	-	-	-	0.58
Snacks and desserts	-	-	-	0.38

The demographic characteristics of the two series (cases and controls) were presented in Table 2. There were significant differences between the two groups in the case of age, sex, BMI, smoking status, and self-reported history of H.Pylori infection.

Table 2
Characteristics of participants in case and control groups

Variables	Gastric cancer patients (n = 192)	Healthy controls (n = 365)	p-value*
Age (years)	59.87 ± 15.24	55.13 ± 15.24	0.001
Sex (males/females)	131/61	193/172	0.001
Education n (%)			0.04
Illiterate/reading and writing	119 (61.97)	193 (52.87)	
≤High school diploma	57 (29.68)	132 (36.16)	
≥ college degree	16 (8.33)	39 (10.68)	
Marital status			0.01
Single	9 (4.68)	39 (10.68)	
Married	165 (85.93)	292 (80)	
Divorced/widow	18 (9.37)	34 (9.31)	
Weight (kg)	64.45 ± 19.09	67.62 ± 17.82	0.06
BMI (kg/m^2)	23.08 ± 6.72	25.36 ± 5.34	< 0.001
Waist circumference	71.47 ± 36.51	73.29 ± 44.37	0.62
Current smoker n (%)	69 (35.93)	64 (17.53)	0.001
Current alcohol consumption	10 (5.20)	13 (3.56)	0.20
History of H.pylori infection (yes)	5 (2.60)	28 (7.67)	0.01
Number of meals/day			
3 meals	129	253	0.65
4 meals	49	86	
≥ 5 meals	14	26	
Drinking hot tea and eating hot food habit yes (%)	155	110	0.005
BMI: body mass index			
*chi-square test for comparison between categorical variables, independent test for comparison between continuous variables			

The association between dietary pattern and gastric cancer is shown in table 3. After adjusting for age, education, marital status, BMI, smoking status, hot tea drinking, and hot food eating habits and history of

H.Pylori infection, males and females in the highest tertiles of “tubers and spices” dietary pattern tended to have 11.42 (4.17, 26.75) and 6.94 (2.24, 21.56) fold higher odds for gastric cancer risk. “Tubers and spices” dietary pattern loaded positively with tubers, spices, vegetables, salt, oils, egg, and legumes. Previous studies showed a positive association between tubers and spices consumption and the risk of gastric cancer [9]. Tubers are rich in starch and nitrite that had been shown as possible risks of gastric cancers. Although there is an inconsistency regarding the association of the nitrite and gastric cancer, a recent meta-analysis study showed that there is a significant positive association between nitrite and gastric cancer risk [15]. Spices were the next food group that has significantly loaded on this dietary pattern. A recent meta-analysis confirmed the significant unfavorable effect of high consumption of spices on gastric cancer [16]. Previous animal studies also showed the carcinogenetic effect of some spices such as chili extract. In addition, human studies showed that high-level consumption of capsaicin-containing foods was associated with an increased risk of cancer [16]. Another food that showed significant loading on this dietary pattern was salt. Salt has been considered as an important risk factor of gastric cancer. The effect of high consumption of salt and salty food on gastric cancer risk can be attributed to its direct effect on gastric mucus and its synergic effect with H.Pylori. Epidemiological studies showed a significant association between salt consumption and H.Pylori infection rate [17]. Another food group that showed high loading on this pattern was vegetables. Although some previous studies showed the protective effect of vegetables in gastric cancer, a recent meta-analysis in East Asian countries could not show this protective effect [18]. Moreover, according to previous studies conducted in Iran, the nitrite content of the vegetables consumed in Iran is higher than the recommended amount of WHO [19]. So, this may additionally justify the observed positive association between this dietary pattern and gastric cancer risk.

The result of the present study showed that in the case of “Western-style” dietary pattern, the risk of gastric cancer is significantly higher in individuals in the highest tertile of this dietary pattern (males: 1.16 (1.00-4.35); females: 2.25 (1.10, 6.49)). In contrast, a “healthy” dietary pattern and “cereals and dairies” dietary pattern was not significantly associated with gastric cancer risk neither in males nor females ($P > 0.05$). This result is consistent with the results of a recent meta-analysis in this regard. In the present study, this pattern was characterized by high consumption of processed meat, high energy drinks, and desserts. It is postulated that these food groups had an unfavorable effect on gastric cancer through increasing overweight and obesity [20].

There was not a significant association between “cereals and dairies” dietary patterns and gastric cancer risk. In the present study, this dietary pattern was characterized by high consumption of cereals and dairy products. Cereals are rich in starch. Previously it has been shown that starchy foods increase the risk of gastric cancer [21]. On the other hand, in earlier studies, the protective effect of dairy products on gastric cancer risk had been demonstrated [22]. So, the absence of an association between this dietary pattern and gastric cancer risk could be attributed to the counteraction effect of these food groups on gastric cancer.

Table 3
Odds ratio of gastric cancer risk by tertiles of dietary patterns.

	Males		Females		Total	
Tubers and spices	OR*	95%CI	OR*	95%CI	OR*	95%CI
T 1	1	-	1	-	1	-
T 2	3.51	1.53-7.96	1.97	0.61-6.22	3.25	1.71-6.16
T 3	11.42	4.87-26.75	6.94	2.24-21.56	9.95	5.25-18.53
p-value for trend	<0.001		0.001		<0.001	
Cereals and dairy products						
T 1	1	-	1	-	1	-
T 2	0.99	0.48-2.07	0.62	0.24-1.55	0.84	0.49-1.45
T 3	1.30	0.60-2.82	0.26	0.08-1.00	0.79	0.44-1.44
p-value for trend	0.29		0.1		0.91	
Healthy dietary pattern						
T 1	1	-	1	-	1	-
T 2	1.08	0.54-2.17	1.27	0.60-4.32	1.18	0.67-2.08
T 3	1.71	0.83-3.50	1.93	0.90-6.99	1.77	1.00-3.16
p-value for trend	0.13		0.07		0.05	
Western-style dietary pattern						
T 1	1	-	1	-	1	-
T 2	1.60	0.73-3.29	3.87	1.70-12.52	2.36	1.25-4.15
T 3	2.06	1.00-4.23	2.85	1.10-6.49	2.63	1.39-4.49
p-value for trend	0.04		0.003		<0.001	

OR: Odds ratio; 95%CI: 95% confidence interval; T: tertile, T1: lowest compliance to dietary pattern, T#: highest compliance to dietary pattern

Adjusted for age, education, marital status, BMI, smoking status, history of H.pylori infection, habit of drinking hot tea or eating hot food

Limitations

In the present study, we used a factor analysis approach. Different steps used in this method are subjective. Moreover, qualitative FFQ was used in the dietary pattern approach. The limitations of this questionnaire also apply to the dietary pattern approach. Moreover, due to using qualitative FFQ, it could not be possible to control the results for energy intake. Additionally, the hospital-based design of the study could be considered as another limitation of the study. Moreover, we did not match controls individually with cases but in the regression analysis, the results were controlled for a large number of potential confounders such as age, dietary behaviors (the number of meals and hot tea drinking, or hot food eating habit), and anthropometric measurements.

Abbreviations

GC
Gastric cancer
H.Pylori
Helicobacter Pylori
FFQ
food frequency questionnaire

Declarations

Ethics approval and consent to participate

The Ethics Committee of Tabriz University of Medical Sciences approved the present study and the written informed consent was obtained from all participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets supporting the conclusions of this research are included in the article.

Competing interests

none

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Authors' contributions

MHS and EF were responsible for the conception and design of the study. ShN and EF were responsible for data acquisition. ZN and MAJ were responsible for data analysis and interpretation. ZN drafted the manuscript; all other authors revised and commented on the draft. All authors read and approved the final version of the manuscript.

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