

Original Article

Factors Affecting Gastric Cancer Using Conditional Logistic Regression Using Bayesian Method: Case-Control StudyArmin Naghipour¹, Abbass Moghimbeigi^{2*}, Jalal Poorolajal³, Abdolazim Sadighi-Pashaki⁴¹Department of Biostatistics, Hamadan University of Medical Sciences, Hamadan, Iran.²Department of Biostatistics and Epidemiology, Faculty of Health & Research Center for Health, Safety and Environment, Alborz University of Medical Sciences, Karaj, Iran.³Department of Epidemiology, School of Public Health, Hamadan University of Medical Sciences, Hamadan, Iran; Research Center for Health Sciences, Hamadan University of Medical Sciences, Hamadan, Iran.⁴Radiology-Oncology Center, MRI Center of Hamadan Darol-Aitam, Hamadan, Iran.

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ABSTRACT

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Introduction: Gastric cancer is one of the most common and deadly cancers in Iran. Gastric cancer is highly dependent on nutritional factors and geographical location. Therefore, the aim of this study was to evaluate the effect of nutritional factors on gastric cancer in Hamadan-Iran.

Methods: This study was performed as a matched case-control study that each case had two controls that matched with cases in age (± 5 years) and gender at Diagnostic and Treatment Center of Mahdieh in Hamedan, Iran. First and second control groups contain persons with and without family history of cancer, respectively. Information of nutritional, epidemiological and confounding variables were collected for 100 cases and 200 controls. Controls from hospital samples, friends and acquaintances of the case group were selected. Data were collected using a researcher-made questionnaire. Data were analyzed using conditional logistic regression by Bayesian method.

Results: Findings showed that, compared with individuals in the case group with the family history group with factors hot food (OR=2.35, 0.95%CrI=(1.82,5.19)), black tea (OR=1.60, 0.95%CrI (1.44,1.72)) cigarettes (OR=2.13, 0.95%CrI=(1.68,2.96)), red meat (OR=4.28, 0.95%CrI=(3.11,8.37)), residence (OR=3.15, 0.95%CrI= (1.62,5.65)), fruit (OR=0.75, 0.95% CrI=(0.63,0.83)) and vegetables (OR=0.76, 0.95%CrI=(0.59,0.85)) there was a strong statistical correlation. The results were also valid for the second control group.

Conclusion: The study showed that many controllable nutritional factors in Hamadan affect the incidence of gastric cancer. It is recommended that policymakers and managers inform the public about the risk factors and prevention of gastric cancer through the publication of brochures, television and newspapers.

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Introduction

Gastric cancer is a major cause of death. World Health Organization (WHO) reports in 2018 showed that stomach cancer is the fourth most common cancer and the third leading cause of death in the world. The results of previous studies indicate that the incidence of gastric cancer in developing countries is higher than in developed countries.^{1,2} Gastric cancer is the first most common cancer in men and the third most common cancer in women in Iran. On the other, Gastric cancer ranks first in death among the cancer.³ A study by Yasar et al. (2019) and the report of the WHO (2019) in the last decade stated that many diseases are decreasing, but the incidence of gastric cancer is increasing in the world and especially in Asian countries.^{4,5} Grabovac et al. (2020), Zha et al. (2020), Prasad et al. (2020) and Zhu et al. (2020) showed that factors such as age, sex, lifestyle, family history, alcohol consumption, red meat consumption, smoking, eating spicy foods and peppers increase the incidence and exercise activities, consumption of onions, garlic, fruits and vegetables reduce the risk of stomach cancer.⁶⁻⁹

Lifestyle in the western provinces of Iran has changed due to population growth, access to Internet information, urbanization and socio-economic status. These changes have a significant impact on the health of individuals in society.^{10, 11} The studies of Rahimi et al. (2012) and Zendehdel et al.(2012) showed that the incidence of gastric cancer in Hamadan province is increasing.^{1, 10} According to the 5-year census of Iran (2016), Hamedan province had 1,738,234 people, and is one of the western cities of Iran.¹²

People with gastric cancer, in addition to the

involvement of the patient, cause stress and psychological problems for the family and cause great pressure on the country's health care system.¹³ Therefore, designing and conducting a study to identify the factors affecting gastric cancer is particular importance. On the other hand, identifying the factors affecting gastric cancer can be one of the main priorities of interventions for policymakers and the Health Organization of Hamadan Province to prevent new cases of this cancer. Therefore, the present study was performed to determine the effective factors, lifestyle modification, and reduce the incidence of gastric cancer in Hamadan province in 2020.

Materials and methods

Study design

The present study is a retrospective and matched case-control study, which was performed between 21 April 2019 - 22 November 2019 in Diagnostic and Treatment Center of Mahdiah in Hamedan-Iran.

Samples and sampling method

Using *pracma* and *powerSurvEpi* packages in R software version 2.0.4 with parameters OR = 1.41,¹⁴ power = 0.80 and $\alpha = 0.05$, sample size for the conditional logistic regression model in the present study N= 100 people were estimated. Sampling was simple and accessible. The case group included patients with gastric cancer diagnosed in the past two years. To compare and determine the factors affecting this disease, two controls (non-patient) were selected for each person in the case group. In other words, to investigate and compare the effect of study factors on the disease in condition to genetic

effects as a confounding variable, a group of control patients was selected from relatives of each patient and a group was also selected from other people. The first group and the second group were controls with and without family history of cancer, respectively. The studies of Toorang et al. (2021), Behar et al. (2020) showed that there is a statistically significant relationship between gastric cancer, age, and sex.^{15,16} Therefore, age and sex were considered confounding variables in the present study. To control the effect of the confounding variable, subjects in the control group were matched with the case group in terms of age (± 5 years) and sex.

Data collection

After obtaining approval from the University Ethics Committee, the researcher referred to Diagnostic and Treatment Center of Mahdiah Clinic for sampling. Mahdiah Diagnostic and Clinic is the main center for admission of patients with gastric cancer in Hamadan province. The researcher stated the objectives of the study for the samples and if they were satisfied, the checklist was given to them and after completion, they were collected.

Variables

We collected data with a checklist that the first of part includes questions about personal information such as gender (0=male, 1=female), age (years), height (centimeters), weight (kilograms), place of residence (0=urban, 1=rural), occupation (0=government, 1= self-employ, 2=unemployed, 3=farmer, 4=retired), education (0=illiterate, 1=elementary/middle, 2=BSc), and the second part includes

questions related to eating habits (bread type (0=sangak, 1=lavash), red meat consumption (0=no, 1=yes), fish consumption (0=no, 1=yes), pickle consumption (0=no, 1=yes), salt consumption (0=no, 1=yes), alcohol consumption (0=no, 1=yes), fruit consumption (0=no, 1=yes), broccoli consumption (0=no, 1=yes), vegetable consumption (0=no, 1=yes), garlic consumption (number in month), onion consumption (number in month), do physical activity in week (minutes) source of drinking water (0=urban, 1=rural), consumption of hot (0=no, 1=yes), and peppery food (0=no, 1=yes)), blood type (0=A, 1=B, 2=O, 3=AB), Do you have stomach cancer? (0=no, 1=yes), family history of cancer (types of cancers (0=no, 1=yes)), and history of smoking (0=no, 1=yes).

Data analysis

The logistic regression model is one of the most widely used statistical models that does not require many assumptions. This model is one of the statistical science methods that can measure the relationship between independent variables and response variables as well as controlling confounding variables. One of the most common topics in logistic regression is disease prediction based on predicted variables.¹⁷

Sometimes the presence of confusing variables causes the actual results of studies not to be reported. One of the ways to control the effect of confounding variables is to match individuals in case and control groups. Usually in case-control studies with two objectives, controlling the effect of the confounding variable and ensuring comparability between the case group and the control group is done. The control group in matching should be selected in such a way

that some of their characteristics are similar to the case group.¹⁸

Conditional logistic regression is used in matched case studies. If conditional logistic regression is not used in these studies, then it is necessary to estimate a large number of parameters related to a class of groups, and in a sense, the sample size decreases at the level of each class. If the sample size increases, then the number of parameters related to each corresponding class increases. Usually, in matched case-control studies, the estimation of the parameter related to the classes is not very important and the fit of the logistic regression model will be skewed. Therefore, the conditional logistic regression model is used to solve the problems of estimating the low parameter of classes and the non-fit of the regression model. Conditional logistic regression eliminates class-related parameters (annoying parameters) and provides a finite estimate for important parameters in the model.^{19, 20}

In the present study, because the number of variables is large and the sample size is small, classical methods do not provide a conditional multiple regression model for the parameters of the multiple logistic regression model due to the small sample size and a large number of variables. Therefore, the Bayesian method was used to estimate the parameters of the multiple conditional logistic regression model.

Random samples are generated from the conditional posterior distribution by the Gibbs sampling method, which is based on Monte Carlo chains. Sampling is done sequentially from the previous distribution, which depends only on the amount of the previous sample. The sampling process continues until the posterior distribution of the parameters converges.^{21, 22}

In the present study, two parallel chains

were run for the initial values of the model parameters. To disperse the distributions and independence between the produced samples, 10,000 dumps were used. Then 20,000 samples were generated with a sampling delay of 20 to estimate the parameters and convergence of the chains. Autocorrelation, history, density, and formal Gelman-Rubin test were used to examine the convergence of Monte Carlo chains. After chain convergence, Bayesian parameter estimation, 0.95% Credible interval (CrI), and DIC (Deviance Information Criterion) were reported. Necessary analyzes were performed to estimate and evaluate convergence under R v 4.0.3 and Open BUGS v 3.2.3 software.

Result

The mean±standard deviation (16) of age in the case group, first control group, and second control group were 63.9±13.0, 64.3±13.4 and 64.2±13.3, respectively. 23 (23%) of the subjects in the case group were women. The subjects in the two control groups were the same in age and sex as the case group. Therefore, the mean age (±5 years) and gender ratio in the case group was equal to the control group. 56 (56.0%) villagers and 92 (92.0%) people added salt to their food and suffering gastric cancer. 51 (51.0%) people in the case group ate red meat monthly, but in the first and second control groups ate 17 (17.0%) and 15 (15.0%) people, respectively. Consumption alcohol (n=41, 59.0%), hot food (n=76, 76.0%) and smoking (n=68, 68.0%) were higher in the case group than in the two control groups. The most consumed vegetables (n=81, 81.0%) and fruits (n=75, 75.0%) are in the second group of controls (Table 1 & Table 2).

The mean number of cup of black tea in the

Table 1. Descriptive characteristics of stomach cancer cases and controls

Variables	Cases (n=100)	Control group 1	Control group 2
	Mean±SD	Mean±SD	Mean±SD
Age (years)	63.9±13.0	64.3±13.4	64.2±13.3
Weight (kg)	70.8±11.9	70.3±11.2	63.9±8.9
Height (cm)	170.4±8.6	170.9±7.8	165±8.8
Number of cups of tea consumed (daily)	7.1±2.6	4.3±2.9	4.1±2.7
Number of eggs consumed (monthly)	21.7±20.3	22.34±24.8	21.5±21.1
Number of garlic consumed (monthly)	16.9±24.7	34.7±65.6	40.6±82.7
Number of onions consumed (monthly)	18.8±17.5	25.3±18.6	26.7±18.9
Do physical activity in week (minutes)	12.2±5.5	25.1±14.6	26.5±16.5

*Control group 1, The control group has a family history of cancer; Control group 2, Control group who do not have a family history of cancer

case group was 7.1±2.6, in the first control group was 4.3±2.9 and in the second control group was 4.1±2.7 cups per day. Mean and standard deviation of number of garlic and number of onion consumption in month and do physical activity in week (minutes) in the second control group (40.6±82.7, 26.7±18.9, 26.5±16.5) it is more than the case group (16.9±24.7, 18.8±17.5, 12.2±5.5) and the first control group (34.7±65.6, 25.3±18.6, 25.1±14.6), respectively (Table 2).

In comparing the case group with first control group (people without a family history of cancer), results showed that odds ratio for stomach cancer 3.15 of residence (rural/urban), (OR = 3.15, 0.95% CrI = (1.62, 5.65)). Also results showed group case the odds ratio with gastric cancer who consume alcohol (yes/no) in compared to the first control group was 3.38 (OR=3.38, 0.95% CrI=(2.58, 5.38)), hot food (yes/no) (OR=2.35, 0.95% CrI=(1.82, 5.19)), cigarettes (yes/no) (OR= 2.13, 0.95% CrI=(1.68, 2.96)), red meat (yes/no) (OR=4.28, 0.95% CrI=(3.11, 8.37)), salt (yes/no) (OR=2.04, 0.95% CrI=(1.28, 3.35)) & spicy food (yes/no) (OR=1.17, 0.95% CrI=(1.13, 1.97)). Findings showed in first control group a significant

inverse association between stomach cancer and intake of vegetables (yes/no) (OR=0.76, 0.95% CrI=(0.59, 0.85)), fish (yes/no) (OR=0.61 (OR=0.61, 0.95% CrI= (0.43, 0.76))), fruits (yes/no) (OR=0.75, 0.95% CrI = (0.63, 0.83)), broccoli (yes/no) (OR= 0.32, 0.95% CrI=(0.20, 0.53)),), per unit increase in consumption of garlic (OR=0.98, 0.95% CrI= (0.98, 0.99)), per unit increase in consumption of onion (OR=0.97, 0.95% CrI=(0.96, 0.99)) and per unit increase in do physical activity in week (OR=0.98, 0.95% CrI=(0.98, 0.99)) (Table 3). Results from the study showed in comparing the case group with second control group (people without a family history of cancer), odds ratio for stomach cancer 2.68 of residence (rural/urban), (OR=2.68, 0.95% CrI=(2.35, 4.11)). Also hot food (yes/no) (OR=3.36, 0.95% CrI=(1.96, 5.18)), cigarettes (yes/no) (OR=2.05, 0.95% CrI (1.99, 3.35)), red meat (yes/no) (OR=4.20, 0.95% CrI=(3.11, 6.21)), salt (yes/no) (OR=1.58, 0.95% CrI=(1.40, 2.02)) & spicy food (yes/no) (OR=1.68, 0.95% CrI=(0.94, 2.62)) risk factor in second control group. But vegetables (OR=0.76, 0.95% CrI=(0.68, 0.81)), fruits (OR=0.79, 0.95% CrI=(0.63, 0.85)), broccoli (OR=0.27, 0.95% CrI=

Table 2. Descriptive characteristics of stomach cancer cases and controls

Variables	Cases		Control group 1		Control group 2	
	n	%	n	%	n	%
Female	23	23.0	23	23.0	23	23.0
Male	77	77.0	77	77.0	77	77.0
Job						
government job	12	12.0	24	24.0	26	26.0
Freelance job	15	15.0	37	37.0	19	19.0
Unemployed	48	48.0	6	6.0	3	3.0
Farmer	18	18.0	7	7.0	6	6.0
Retired	7	7.0	24	24.0	46	46.0
Residence of rural area						
Yes	56	56.0	79	79.0	81	81.0
No	44	44.0	21	21.0	19	19.0
What kind of bread do you eat the most?						
Sangak	26	26.0	46	46.0	55	55.0
Lavash	74	74.0	54	54.0	45	45.0
You consume pickles several times						
No	10	10.0	23	23.0	26	26.0
Monthly	10	10.0	31	31.0	28	28.0
Weekly	32	32.0	31	31.0	30	30.0
Daily	48	48.0	15	15.0	16	16.0
Do you add salt to food at the table						
No	8	8.0	16	16.0	19	19.0
Yes	92	92.0	84	84.0	81	81.0
Do you eat red meat for a month?						
No	49	49.0	81	83.7	84	84.9
Yes	51	51.0	17	17.3	15	15.1
Do you eat fish meat for a month?						
No	45	45.0	40	40.0	42	42.0
Yes	55	55.0	60	60.0	58	58.0
How do you eat more food?						
Boiled	27	27.0	66	66.0	54	54.5
Fried	73	73.0	34	34.0	45	45.0
Have you consumed alcohol in a month?						
No	28	41.0	69	73.0	64	76.0
Yes	41	59.0	25	27.0	20	24.0
You ate fruit in your weekly diet						
No	57	57.0	27	27.0	25	25.0
Yes	43	43.0	73	73.0	75	75.0
You ate vegetables in your weekly diet						
No	41	41.0	20	20.0	19	19.0
Yes	59	59.0	80	80.0	81	81.0
You had rice in your weekly diet						
No	63	63.0	81	81.0	73	73.0
Yes	37	37.0	19	19.0	27	27.0
Do you like hot food						
No	24	24.0	56	56.0	51	51.0
Yes	76	76.0	44	44.0	49	49.0

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Variables	Cases		Control group 1		Control group 2	
	n	%	n	%	n	%
Do you like spicy food?						
No	24	24.0	56	56.0	51	51.0
Yes	76	76.0	44	44.0	49	49.0
What is the source of daily drinking water?						
Urban water source	41	41.0	94	94.0	90	90.0
Rural water source	59	59.0	6	6.0	10	10.0
Eat broccoli for a month						
No	75	75.0	46	46.0	50	50.0
Yes	25	25.0	54	54.0	50	50.0
Do you consume carbonated beverages such as soft drinks, delights, carbonated buttermilk						
No	22	22.0	30	30.0	32	32.0
Yes	78	78.0	70	70.0	68	68.0
Type of blood type in case of blood test to determine blood type						
A	25	26.3	33	39.8	36	41.9
B	9	9.5	19	22.9	23	20.1
O	59	62.1	29	34.3	30	34.9
AB	2	2.1	00	00.0	7	8.1
Do you have a family history of cancer (types of cancers)						
No	42	42.0	100	100	00	00.0
Yes	58	58.0	00	00.0	100	100
If so, what relationship do they have with you?						
None	42	42.0	100	100	00	00.0
First-degree relatives	35	35.0	00	00.0	43	43.0
2nd-degree relatives	23	23.0	00	00.0	57	57.0
Do you have a family history of stomach cancer?						
Yes	36	36.0	00	00.0	55	55.0
No	64	64.0	100	100	45	45.0
If so, what relationship do they have with you?						
None	65	65.0	100	100	45	45.0
1 nd -degree relatives	22	22.0	00	00.0	13	13.0
2 nd -degree relatives	13	13.0	00	00.0	42	42.0
Level of education						
Illiterate	62	62.0	14	14.0	11	11.0
Elementary/middle	31	31.0	64	64.0	66	66.0
BSc	7	7.0	22	22.0	23	23.0
Have you smoked more than 5 cigarettes a day in the last 10 years?						
No	32	32.0	63	63.0	73	73.0
Yes	68	68.0	37	37.0	27	27.0

* 1nd-degree relatives: parents / siblings / uncles, aunts / uncles, aunts.

(0.18, 0.34)), per unit increase in consumption garlic (OR=0.99, 0.95% CrI=(0.98,0.99)), per unit increase in consumption onion (OR=0.98, 0.95% CrI=(0.96,0.99)) & per unit increase in do physical activity in week (OR=0.99,

0.95% CrI=(0.98,0.99))) a significant inverse association to stomach cancer (Table 3).

Findings of this study showed that in the case group, people with blood type O/ blood type A were 2.39 times more likely to develop gastric

Table 3. Association between stomach cancer and intake food groups of interest among cases and controls

Variables	Control group 1		Control group 2	
	Unadjusted OR (95 % CrI)	DIC	Unadjusted OR (95 % CrI)	DIC
BMI	1.07(0.97,1.09)	279.9	1.11(0.98,1.12)	277.4
Number tea cups	1.60(1.44,1.72)	205.4	1.54(1.53,1.62)	230.3
Number egg (in month)	1.00(0.99,1.01)	263.2	1.00(0.99,1.01)	250.3
You have garlic intake	0.98(0.98,0.99)	272.9	0.99(0.98,0.99)	269.9
You have onion (in month)	0.97(0.96,0.99)	269.0	0.98(0.96,0.99)	276.0
Do physical activity in week	0.98(0.98,0.99)	229.3	0.99(0.98,0.99)	276.3
Job				
Government job	1 (Ref.)	236.3	1 (Ref.)	273.1
Self-employ job	1.23(0.31,3.53)		1.05(0.86,3.41)	
Unemployed	9.32(4.72,25.03)		2.39(0.90,8.23)	
Farmer	5.92(4.21,29.52)		4.00(2.22,16.06)	
Retired	1.21(0.82,13.73)		0.81(0.70,2.21)	
Residence of rural area				
No	1 (Ref.)	268.1	1 (Ref.)	261.3
Yes	3.15(1.62,5.65)		2.68(2.35,4.11)	
What kind of bread do you eat the most?				
Sangak	1 (Ref.)	263.5	1 (Ref.)	272.6
Lavash	3.69(1.96,6.47)		2.57(1.36,4.51)	
You consume pickles several times				
No	1 (Ref.)	233.3	1 (Ref.)	299.1
Monthly	2.13(1.10,5.71)		0.79(0.28,7.17)	
Weekly	6.52(4.99,19.38)		2.87(1.18,7.21)	
Daily	7.71(4.61,18.21)		16.44(4.48,33.71)	
Do you add salt to food at the table				
No	1 (Ref.)	301.3	1 (Ref.)	273.1
Yes	2.04(1.28,3.35)		1.58(1.40,2.02)	
Do you eat red meat for a month?				
No	1 (Ref.)	249.6	1 (Ref.)	247.7
Yes	4.28(3.11,8.37)		4.20(3.11,6.21)	
Do you eat fish meat for a month?				
No	1 (Ref.)	270.9	1 (Ref.)	269.5
Yes	0.60(0.44,0.67)		0.58(0.36,0.64)	
How do you eat more food?				
Boiled	1 (Ref.)	261.9	1 (Ref.)	238.3
Fried	1.38(1.30,1.70)		3.60(3.33,6.22)	
Have you consumed alcohol in a month?				
No	1 (Ref.)	270.1	1 (Ref.)	273.7
Yes	3.38(2.58,5.38)		1.21(0.83,2.33)	
You ate fruit in your weekly diet				
No	1 (Ref.)	256.1	1 (Ref.)	261.5
Yes	0.75(0.63,0.83)		0.79(0.63,0.85)	

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Variables	Control group 1		Control group 2	
	Unadjusted OR (95 % CrI)	DIC	Unadjusted OR (95 % CrI)	DIC
You ate vegetables in your weekly diet (Month)				
No	1 (Ref.)	259.7	1 (Ref.)	263.8
Yes	0.76(0.59,0.85)		0.76(0.68,0.81)	
You had rice in your weekly diet				
No	1 (Ref.)	274.0	1 (Ref.)	271.2
Yes	1.68(0.86,2.01)		2.28(1.56,3.14)	
Do you like hot food				
No	1 (Ref.)	254.5	1 (Ref.)	
Yes	2.35(1.82,5.19)		3.36(1.96,5.18)	261.5
Do you like spicy food?				
No	1 (Ref.)	280.1	1 (Ref.)	277.4
Yes	1.17(1.13,1.97)		1.68(0.94,2.62)	
What is the source of daily drinking water?				
Urban water source	1 (Ref.)	244.0	1 (Ref.)	246.6
Rural water source	1.18(1.02,1.20)		4.04(3.24,12.35)	
Eat broccoli for a month				
No	1 (Ref.)	261.8	1 (Ref.)	260.4
Yes	0.32(0.20,0.53)		0.27(0.18,0.34)	
Do you consume carbonated beverages such as soft drinks, delights, carbonated buttermilk				
No	1 (Ref.)	281.6	1 (Ref.)	281.1
Yes	1.18(0.36,1.45)		1.24(0.63,1.82)	
Type of blood type in case of blood test to determine blood type				
A	1 (Ref.)	238.8	1 (Ref.)	248.6
B	1.90(0.41,1.57)		2.44(1.24,5.35)	
O	2.86(1.68,4.58)		7.53(3.99,19.88)	
AB	0.00(0.00,0.00)		0.73(0.68,2.81)	
Level of education				
Illiterate	1 (Ref.)	273.6	1 (Ref.)	270.4
Elementary/middle	0.21(0.03,0.33)		0.28(0.18,0.58)	
BSc	0.98(0.98,0.99)		0.39(0.20,0.59)	
Have you smoked more than 5 cigarettes a day in the last 10 years?				
No	1 (Ref.)	280.1	1 (Ref.)	279.3
Yes	2.13(1.68,2.96)		2.05(1.99,3.35)	

*Control group 1, Control group who do not have a family history of cancer; Control group 2, The control group has a family history of cancer; Odds estimation in conditional logistic regression model a significance level of 0.05; Deviance Information Criterion

cancer than the first control group, assuming that other variables were constant in multiple models and those with no family history of cancer (OR=2.39, 0.95% CrI=(1.18, 4.12)).

Also, in the case group, people with blood type O/ blood type A were 3.70 times more likely to develop gastric cancer than the first control group, assuming that other variables were

Table 4. Association between stomach cancer and intake food groups of interest among cases and controls

Variables	Control group 1	Control group 2
	Adjusted OR (95 % CrI)	Adjusted OR (95 % CrI)
BMI	1.01(0.98,1.19)	1.22(1.15,1.52)
number tea cups	1.48(1.47,1.53)	1.38(1.29,2.21)
Number egg (in month)	1.00(0.98,1.01)	1.01(0.99,1.03)
You have garlic intake	0.98(0.98,0.99)	0.96(0.94,0.99)
You have onion (in month)	0.98(0.97,0.98)	0.98(0.96,0.99)
Do physical activity in week	0.98(0.96,0.98)	0.97(0.94,0.99)
Job		
government job	1 (Ref.)	1 (Ref.)
Freelance job	1.43(0.31,3.54)	2.54(0.68,9.04)
Unemployed	9.32(4.76,25.02)	21.11(4.67,18.54)
farmer	5.92(4.21,29.52)	3.29(0.17,20.19)
Retired	1.51(0.82,13.75)	0.99(0.18,22.45)
Residence of rural area		
No	1 (Ref.)	1 (Ref.)
Yes	1.09(1.38,3.64)	1.29(1.18,5.04)
What kind of bread do you eat the most?		
Sangak	1 (Ref.)	1 (Ref.)
Lavash	3.90(1.56,6.43)	2.57(1.36,4.51)
You consume pickles several times		
No	1 (Ref.)	1 (Ref.)
Monthly	1.93(0.92,6.80)	2.71(0.88,10.40)
Weekly	2.63(0.73,10.30)	10.11(10.09,12.50)
Daily	7.84(1.22,18.18)	11.82(6.66,39.27)
Do you add salt to food at the table		
No	1 (Ref.)	1 (Ref.)
Yes	1.76(1.28,4.38)	1.53(1.40,2.12)
Do you eat red meat for a month?		
No	1 (Ref.)	1 (Ref.)
Yes	3.33(3.11,8.37)	6.14(2.90,27.36)
Do you eat fish meat for a month?		
No	1 (Ref.)	1 (Ref.)
Yes	0.23(0.11,0.47)	0.68(0.36,0.74)
How do you eat more food?		
Boiled	1 (Ref.)	1 (Ref.)
Fried	1.48(1.15,1.80)	3.60(3.36,5.22)
Have you consumed alcohol in a month?		
No	1 (Ref.)	1 (Ref.)
Yes	1.96(0.71,2.19)	3.91(2.44,20.41)
You ate fruit in your weekly diet		
No	1 (Ref.)	1 (Ref.)
Yes	0.32(0.17,0.93)	0.20(0.07,0.99)
You ate vegetables in your weekly diet (Month)		
No	1 (Ref.)	1 (Ref.)
Yes	0.79(0.67,0.90)	0.76(0.19,0.81)
You had rice in your weekly diet		
No	1 (Ref.)	1 (Ref.)

Variables	Control group 1	Control group 2
	Adjusted OR (95 % CrI)	Adjusted OR (95 % CrI)
Yes	1.28(0.96,2.22)	1.31(1.56,3.15)
Do you like hot food		
No	1 (Ref.)	1 (Ref.)
Yes	2.03(0.92,5.57)	2.33(1.40,9.09)
Do you like spicy food?		
No	1 (Ref.)	1 (Ref.)
Yes	1.27(1.13,1.97)	1.64(0.93,2.86)
What is the source of daily drinking water?		
Urban water source	1 (Ref.)	1 (Ref.)
Rural water source	2.51(2.13,33.89)	15.42(4.91,18.04)
Eat broccoli for a month		
No	1 (Ref.)	1 (Ref.)
Yes	0.28(0.21,0.57)	0.27(0.18,0.34)
Do you consume carbonated beverages such as soft drinks, delights, carbonated buttermilk		
No	1 (Ref.)	1 (Ref.)
Yes	2.17(1.39,3.23)	1.30(0.68,1.86)
Type of blood type in case of blood test to determine blood type		
A	1 (Ref.)	1 (Ref.)
B	0.72(0.52,1.38)	1.39(0.52,5.28)
O	2.42(1.26,4.62)	1.90(1.37,2.91)
AB	0.00(0.00,0.00)	1.02(0.01,3.25)
Level of education		
Illiterate	1 (Ref.)	1 (Ref.)
Elementary/middle	0.15(0.03,0.33)	0.31(0.20,0.56)
BSc	0.98(0.98,0.99)	0.39(0.23,0.55)
Have you smoked more than 5 cigarettes a day in the last 10 years?		
No	1 (Ref.)	1 (Ref.)
Yes	1.60(1.20,2.26)	4.29(1.92,7.23)

*Odds estimation in multiple models of conditional

constant in multiple models (OR=3.70, 0.95% CrI=(0.52, 6.18)) (Table 4).

Discussion

Job

Results showed that farmers in both control groups were more likely to develop gastric cancer than other occupations. According to the above findings, the studies of Zhang et al. (2020), Chen et al. (2019) and meta-analysis

study Acquavella et al. (1998), reported agricultural occupation as a high-risk factor for gastric cancer.²³⁻²⁵ Also, the source of water consumption, lack of sanitary facilities, and direct contact with agricultural pesticides are associated with gastric cancer.²⁶ It seems that because farmers consumed untreated water from springs and wells and had direct contact with toxins, it increased the chances of stomach cancer in farmers.

Black tea

Findings show that consuming black tea increases the chances of stomach cancer. Studies by Chen et al. (2019) and Chen et al. (2011) reported a statistically significant relationship between tea consumption and gastric cancer.^{24, 27} The dose and the temperature of tea affect gastric cancer.²⁴ Consumption of hot tea causes damage to the gastric and esophageal mucosa and creates conditions for stomach cancer.

Consumption of fruits and vegetables

The results showed that there was a statistically significant inverse relationship between consumption of vegetables, cabbage, garlic, and onions with gastric cancer. Findings of the present study with Morrison et al studies. (2020), Wang et al. (2018), Poirier et al. (2019) and meta-analysis study Poorolajal et al. (2020) is consistent.²⁸⁻³¹ Fruits and vegetables may contain fiber, which regulates metabolic enzymes during the digestive process. On the other hand, fruits and vegetables contain many antioxidants that prevent metabolic damage.

Habitat

Findings show that villagers are more fortunate to have stomach cancer; These results are consistent with studies by Majeed et al.²⁰²⁰ and Jaka et al. (2016) were consistent.^{32, 33} This difference may be due to the source of untreated drinking water, the level of public health, and less access to health centers in the countryside.

Water supply

The results showed that people who drank

from a rural drinking water source (spring, well, rural water source) had a higher chance of developing gastric cancer than people who drank from an urban water source. The findings of the present study with a study by Afzal et al. (2020) were in line.²⁶ The presence of chlorine in drinking water increases the risk of gastric cancer.³⁴ Chlorine may be present in the drinking water of the villagers of Hamedan province, and this has caused stomach cancer among the villagers.

Blood group

In the present study, the findings indicate that there was a statistically significant relationship between gastric cancer and blood group. People with blood group O were more likely to get stomach cancer, with the results of Majeed et al studies. (2020) and Christian et al. (2018) In line with the studies of Muhemmed et al. (2016) and Shaldoum et al. (2015) were contradictory.^{32, 35-37} According to previous studies, blood group O is strongly associated with *Helicobacter pylori* infection.^{32, 36} People with group C gastric cancer may have an increased chance of developing *Helicobacter pylori*.

Alcohol and cigarettes

The results showed that alcohol and cigarette consumption had a statistically significant relationship with gastric cancer. Results in line with Ramos et al studies (2018), Rawla et al. (2019) and meta-analysis study Poorolajal et al. (2020) were consistent.^{31, 38, 39} Alcohol can impair gastric function and damage the gastric mucosa, and by repeating this action a person may develop a stomach ulcer or duodenal ulcer.

According to previous studies, gastric and duodenal ulcers have a statistically significant relationship with gastric cancer.³⁹ On the other hand, some alcoholic beverages contain nitrosamines, which are known to cause gastric cancer. The mechanism of carcinogenicity in esophageal tumors is related to the direct effect of cigarette smoke, which by ingesting food causes the transfer of tobacco-related particles to the stomach.

Salt and pickles

The results of the study showed that high salt intake and daily intake of pickles have a statistically significant relationship with gastric cancer. This study with Rawla et al studies. (2019), Liu et al. (2015) and meta-analysis study Poorolajal et al. (2020) were consistent.^{31, 39, 40} Eating salty and sour foods a day causes gastritis, which in turn causes inflammation and elimination of gastric mucosa. Consumption of salty and sour foods depends on the culture and lifestyle of the people in the community.

One of the limitations of this study was the incompleteness of the checklist and the self-evident process of completing the questionnaire, which may not reflect all the realities of society. Therefore, for the subjects, the purpose, and importance of the subject were clearly explained so that individuals report their statements as realistically as possible. Another limitation is related to the nature of cross-sectional studies and therefore it is not possible to determine the cause-and-effect relationships between the variables studied.

Conclusion

Results of the study showed that there was no significant difference between the factors associated with gastric cancer compared with the first control group and the second control group. Between stomach cancer and variables number of teacups, the number of garlic cloves and onions consumed per month, sports activity, occupation, place of residence, consumption of pickles, consumption of red meat and fish, consumption of fruits, vegetables, broccoli, drinking water source, blood group, and smoking was found to be statistically significant. Therefore, it is recommended that health-education programs be developed by policymakers and that the preventive factors and risk factors affecting gastric cancer be informed in person and through the media. It is suggested that the same measures be taken to prevent and inform both groups. For future study suggest that in future studies in the form of qualitative studies, the effects of intervention measures on the incidence of gastric cancer in Hamadan province be investigated.

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