

RESEARCH ARTICLE

A Population-based Case-control Study on Risk Factors for Gastric Cardia Cancer in Rural Areas of Linzhou

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Abstract

Gastric cancer is the second most common cause of cancer-related deaths in the world. Although certain dietary factors and lifestyles have been suggested to be associated with gastric carcinogenesis, there have been few investigations focusing on rural areas. A case-control study was therefore carried out to investigate the risk factors of gastric cardia cancer (GCC) in rural areas of Linzhou. A total of 470 newly diagnosed cases of GCC and 470 healthy controls were included. Face-to-face interviews were conducted, using a uniform questionnaire containing questions on demographics, per capita income, living habits, dietary habits and family history of tumors. The relationship between putative risk factors and GCC was assessed by odds ratios (OR) and their 95% confidence intervals (95% CI) derived from conditional logistic regression model by the COXREG command using SPSS 12.00. Multivariate logistic regression analysis was used to evaluate simultaneously the effects of multiple factors and other potential confounding factors. Multivariate logistic analysis showed that smoking (OR=1.939, 95% CI:1.097-3.426), alcohol drinking (OR=2.360, 95% CI: 1.292-4.311), hot food consumption (OR=2.034, 95% CI: 1.507-2.745), fast eating (OR=1.616, 95% CI: 1.171-2.230), mouldy food (OR=4.564, 95% CI: 2.682-7.767), leftover food (OR=1.881, 95% CI: 1.324-2.671), and family history of tumor (OR=2.831, 95% CI: 1.588-5.050) were risk factors for GCC. High per capita income (OR=0.709, 95% CI: 0.533-0.942), high education level (OR=0.354, 95% CI: 0.163-0.765), consumption of fresh fruits (OR=0.186, 95% CI: 0.111-0.311) and vegetables (OR=0.243, 95% CI: 0.142-0.415), and high BMI (OR=0.367, 95% CI: 0.242-0.557) were protective factors for GCC. Our data indicate that unhealthy lifestyle and dietary habits might be important contributors to GCC in this population.

Keywords: Case-control study - risk factor - gastric cardia cancer - dietary habits - rural Linzhou, China

Asian Pacific J Cancer Prev, 14 (5), 2897-2901

Introduction

Gastric cancer can be divided into two types including gastric cardia cancer, which occurs in the top portion of the stomach near the junction of the esophagus, and non-cardia gastric cancer which may be found in all other areas of the stomach. Gastric cancer is the second most common cause of cancer-related deaths in the world, killing approximately 738,000 people in 2008 (Ferlay et al., 2010). Gastric cancer is less common in the United States and other Western countries than in countries in Asia and South America (Ferlay et al., 2010). In the last two decades, although incidence rate of non-cardia gastric cancer has slightly declined, gastric cardia cancer has shown a significantly increased trend in China (He et al., 2008). Since most patients in early stage of gastric cardia cancer have no obvious symptoms, the early diagnosis of gastric cardia cancer is challenging. Therefore, despite the advances in treatment strategies, gastric cardia cancer still has a dismal prognosis, with much lower 5-year-survival-rate compared with cancer at the pyloric antrum (Crew

et al., 2006). The rapid increase in incidence and poor prognosis of gastric cardia cancer highlight the importance of prevention against the disease.

Linzhou (formerly Linxian) and the nearby counties have the highest incidence and mortality area for esophageal cancer and gastric cardia cancer in the world (Parkin et al., 2001; Wang et al., 2005) and is situated in the northwest of Henan province in the Taihang mountain area, China. As an agriculture area, there is 80% population living in the nearby counties of Linzhou, with a total population of 1 million. Recent studies indicate that the incidence rate of gastric cardia cancer is as high as esophageal cancer in the high-incidence area of esophageal cancer. Epidemiological studies also have reported an increasing incidence of gastric cardia cancer in some Asian countries during the past few decades (Blaser et al., 2002; Tony et al., 2007; Kusano et al., 2008; Zhou et al., 2008; Deans et al., 2011), owing to the development of the early diagnosis of gastric cardia cancer and its clear definition. Screening program of esophageal and gastric cardia cancer screening of Linzhou in 2005-

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2006 has proofed it and has also showed the rise of the ratio of esophageal to gastric cardia cancer. In 2005, the program named "Early Detection and Early Treatment of Esophageal and Cardia Cancer" (EDETEC) was initiated in three high risk areas in China. All the population aged 40-69 years in randomly selected villages of Linzhou participated the EDETEC program with the help of funding from Chinese Central Financial Transfer Payment Program.

Although certain lifestyles and dietary factors such as irregular meal, over and fast eating, consumption of salty fish or pickled vegetable, have been suggested to be associated with the gastric carcinogenesis (Cai et al., 2003), there are few investigations focusing on the risk factors in the rural areas. Lifestyles and dietary habits might contribute the high incidence of gastric cardia cancer in Linzhou. To clarify the risk factors of gastric cardia cancer and provide a scientific guide for local residents, we have conducted a case-control study in the rural areas of Linzhou.

Materials and Methods

Study subjects

470 newly diagnosed (less than 3 months) patients of gastric cardia cancer, which were pathologically diagnosed through the first surgical operation in Tumor Hospital of Linzhou City from 2005 to 2007 were selected as cases. A total of 4043 residents aged 40-69 years old were recruited into the EDETEC program in Linzhou of Henan Province between 2007 and 2008, and were screened by endoscopy with mucosal iodine staining in combination with index biopsies, and then diagnosed by pathology detection. 470 healthy residents according the screening results agreed to participate in this study as controls. Both the cases and controls have histological examination of biopsy using gastroscopy. The participants with any disease of digestive system were excluded from control group, such as atrophic gastritis, inflammation, hyperplasia, intestinal metaplasia diagnosed through biopsy. The cases and controls were individually matched in gender, age (within 3 years) and race. All the subjects must have lived in the nearby counties of Linzhou for more than 10 years before Jan 1th 2005, aged between 40 and 69 years.

Epidemiological investigation

Face-to-face interviews were conducted by trained investigators, in which a uniform questionnaire containing demographic characteristics (such as, age, gender, nation, level of education, marital status, occupation, height, weight, per capita income), living habits (such as, smoking, passive smoking and alcohol drinking), dietary habits (pickled food, hot food, fried food, moldy food, leftover food, overeating, speed of eating salt taste), food frequency (fresh vegetables and fresh fruits), family history of tumor. Food frequency questionnaire can be used as food intake, which has been validated by a method of 3 days weighted food record. In addition, cases were interviewed on the evening before the surgeries, and retrospective investigation was carried on for the living habits and dietary habits one year before the diagnosis

of gastric cardia cancer. The study protocol had been approved by the Institutional Review Board and this study was conducted in accordance with the principles articulated in the Declaration of Helsinki of 1975. All the participants in both groups voluntarily joined the study with informed consents.

Definition of the variables

Smoking was defined as ≥ 1 cigarette per day for at least 6 months in one's lifetime, and alcohol drinking means drinking at least twice (beer ≥ 500 ml or liquor ≥ 50 ml) per week for at least 6 months in one's lifetime. BMI=weight (kg)/height (m²). Passive smoking means the inhalation of smoke by persons other than the intended 'active' smoker more than 15 min per day.

Quality control

Data quality control includes: (1) All the participants have specific pathological diagnosis using gastroscopy. (2) All the investigators have been trained professionally before formal interview (3) In order to reduce the recall bias, data were mainly collected from the subjects themselves, except for the patient who cannot remember clearly. (4) Education and knowledge of preventing gastrointestinal cancer were widely carried out in high-incidence area, so that we can get active co-operation.

Statistical analyses

The questionnaire was numbered and the database was established by Epidata 3.0. The data were statistically evaluated with SPSS 12.00. Chi-square tests were performed to get the *P* value of trend between the risk factors and gastric cardia cancer. The relationship between the putative risk factors and the gastric cardia cancer was assessed by odds ratios (OR) and their 95 % confidence intervals (95% CI) derived from univariate conditional logistic regression model by the COXREG command. Multivariate logistic regression analysis was used to evaluate simultaneously the effects of multiple factors and other potential confounding factors. The group with no exposure or the group with the lowest level of exposure was used as the baseline group. All the *P* values were for a two-sided test and *P* <0.05 was considered as statistically significant.

Table 1. Demographic Characteristics Between Gastric Cardiac Cancer (GCC) Patients and Controls

Variables	Controls (%)	Cases (%)	OR	95%CI	<i>P</i>
Sex					
Male	390(82.98)	390(82.98)			
Female	80(17.02)	80(17.02)			
Age (years)					
Mean \pm SD	57.19 \pm 6.72	57.45 \pm 6.71			
Nationality					
Han	467(99.36)	467(99.36)			
Hui	3(0.67)	3(0.67)			
Marital status					
Married	442 (94.04)	437 (92.98)			
Divorced or widowed	28 (5.96)	33 (7.02)			
Per capita income (RMB/year)					<0.001
<2000	156 (33.19)	198 (42.13)	1		
2000~	178 (37.87)	179 (38.09)	0.76	0.56-1.04	
5000~	69 (14.68)	57 (12.13)	0.62	0.41-0.94	
>8000	67 (14.26)	36 (7.66)	0.38	0.23-0.63	
Education level					<0.001
Primary school or below	346 (73.62)	397 (84.47)	1		
Middle school or below	124 (26.38)	73 (15.53)	0.35	0.22-0.54	

Table 2. Univariate Conditional Logistic Regression Analysis of Risk of GCC

Variables	Controls (%)	Cases (%)	ORa	95%CIb	P
Per capita income (RMB/year)					
<2000	156 (33.19)	198 (42.13)	1		
2000~	178 (37.87)	179 (38.09)	0.76	0.56-1.04	0.084
5000~	69 (14.68)	57 (12.13)	0.62	0.41-0.94	0.026
>8000	67 (14.26)	36 (7.66)	0.38	0.23-0.63	<0.001
Trend	<i>P</i> <0.001				
Education level					
Primary school or below	346 (73.62)	397 (84.47)	1		
Middle school or below	124 (26.38)	73 (15.53)	0.35	0.22-0.54	<0.001
Active smoking					
No	276(58.72)	190(40.43)	1		
Yes	194(41.28)	280(59.57)	2.59	1.89-3.55	<0.001
Active and passive smoking					
No	251(53.40)	128(27.23)	1		
Yes	219(46.60)	342(72.77)	3.51	2.56-4.82	<0.001
Alcohol drinking					
No	411(87.45)	299(63.62)	1		
Yes	59(12.55)	171(36.38)	3.73	2.64-5.27	<0.001
Family history of tumor					
Yes	106(22.55)	152(32.34)	1		
No	364(77.45)	318(67.66)	1.62	1.21-2.17	0.001
BMI (kg/m ²)					
<18.5	61(12.98)	135(28.72)	1		
18.5~	300(63.83)	290(61.70)	0.47	0.33-0.66	<0.001
≥25	109(23.19)	45(9.57)	0.21	0.14-0.34	<0.001
Trend	<i>P</i> <0.001				

a: OR, odds ratio; b: CI, confidence interval

Table 3. Univariate Conditional Logistic Regression Analysis in Relation to Dietary Factors of GCC

Variables	Controls (%)	Cases (%)	ORa	95%CIb	P
Hot food taking					
Never	225(47.87)	95(20.21)	1		
1-2 times /week	52(11.06)	75(15.96)	3.25	2.05-5.16	<0.01
≥ 2 times/ week	193(41.06)	300(63.83)	3.64	2.63-5.04	<0.01
Trend	<i>P</i> <0.001				
Overeating					
No	359(76.38)	343(72.98)	1		
Yes	111(23.62)	127(27.02)	1.21	0.89-1.64	0.218
Speed of eating					
Slow	111(23.62)	51(10.85)	1		
Medium	163(34.68)	118(25.11)	1.49	0.98-2.28	0.065
Fast	196(41.70)	301(64.04)	3.52	2.35-5.26	<0.01
Trend	<i>P</i> <0.001				
Salt taste					
Low	72(15.32)	83(17.66)	1		
Moderate	184(39.15)	177(37.66)	0.83	0.57-1.21	0.342
High	180(38.30)	157(33.40)	0.75	0.51-1.11	0.147
Very high	34(7.23)	53(11.28)	1.35	0.75-2.31	0.268
Trend	<i>P</i> =0.880				
Pickled food taking					
Never	158(33.62)	139(29.57)	1		
1-2 times/week	212(45.11)	205(43.62)	1.09	0.80-1.48	0.578
≥ 2 times/week	100(21.28)	126(26.81)	1.46	1.02-2.09	0.038
Trend	<i>P</i> =0.048				
Fried food taking					
Never	49(10.43)	42(8.94)	1		
1-2 times/week	308(65.53)	284(60.43)	1.06	0.69-1.63	0.578
≥ 2 times/week	113(24.04)	144(30.64)	1.46	0.91-2.33	0.038
Trend	<i>P</i> =0.033				
Moldy food taking					
Never	432(91.91)	331(70.43)	1		
1-2 times /week	24(5.11)	80(17.02)	3.92	2.41-6.40	<0.001
≥ 2 times/ week	14(2.98)	59(12.55)	5.17	2.75-9.70	<0.001
Trend	<i>P</i> <0.001				
Leftover food taking					
Never	128(27.23)	94(20.00)	1		
1-2 times/week	212(45.11)	189(40.21)	1.21	0.87-1.68	0.267
≥ 2 times/week	130(27.66)	187(39.79)	1.9	1.35-2.69	<0.001
Trend	<i>P</i> <0.001				
Fresh vegetables intake					
<150 g/d	42(8.94)	143(30.43)	1		
150~400 g/d	350(74.47)	296(62.98)	0.23	0.15-0.35	<0.001
>400 g/d	78(16.60)	21(4.47)	0.1	0.06-0.19	<0.001
Trend	<i>P</i> <0.001				
Fresh fruits intake					
<50 g/d	188(40.00)	363(77.23)	1		
50~100 g/d	219(46.60)	98(20.85)	0.24	0.17-0.33	<0.001
>100 g/d	63(13.40)	9(1.91)	0.07	0.03-0.15	<0.001
Trend	<i>P</i> <0.001				

a: OR, odds ratio; b: CI, confidence interval

Results

Characteristics of the subjects

A total of 940 subjects from 40 to 69 years old

Table 4. Univariate Conditional Logistic Regression Analysis in Relation to Dietary Factors of GCC According to Sex

Variables	Male			Female		
	ORa	95%CIb	P	ORa	95%CIb	P
Hot food taking						
Never	1			1		
1-2 times/week	3.19	1.94-5.24	<0.001	3.29	0.91-11.87	0.069
≥ 2 times/week	3.9	2.77-5.65	<0.001	2.25	0.97-5.22	0.058
Trend	<i>P</i> <0.001			<i>P</i> =0.110		
Overeating						
No	1			1		
Yes	1.32	0.93-1.86	0.118	0.895	0.47-1.72	0.739
Speed of eating						
Slow	1			1		
Medium	1.7	1.04-2.77	0.035	1.11	0.45-2.74	0.814
Fast	4.49	2.81-7.19	<0.001	1.36	0.59-3.12	0.474
Trend	<i>P</i> <0.001			<i>P</i> =0.467		
Salt taste						
Low	1			1		
Moderate	0.96	0.63-1.45	0.843	1.45	0.43-4.92	0.552
High	0.81	0.53-1.24	0.328	0.6	0.21-1.75	0.351
Very high	1.59	0.86-2.85	0.144	0.8	0.26-2.42	0.687
Trend	<i>P</i> =0.709			<i>P</i> =0.655		
Pickled food taking						
Never	1			1		
1-2 times/week	1.09	0.77-1.52	0.636	1.11	0.55-2.25	0.727
≥ 2 times/week	1.5	1.01-2.23	0.045	1.31	0.57-2.99	0.529
Trend	<i>P</i> =0.060			<i>P</i> =0.525		
Fried food taking						
Never	1			1		
1-2 times/week	1.08	0.67-1.74	0.751	0.92	0.69-1.63	0.876
≥ 2 times/week	1.3	0.78-2.18	0.308	2.93	0.91-2.33	0.081
Trend	<i>P</i> =0.200			<i>P</i> =0.017		
Moldy food taking						
Never	1			1		
1-2 times/week	4.49	2.59-7.70	<0.001	2.33	0.60-9.02	0.219
≥ 2 times/week	3.72	1.95-7.07	<0.001	8.17	0.95-10.70	0.874
Trend	<i>P</i> <0.001			<i>P</i> <0.001		
Leftover food taking						
Never	1			1		
1-2 times/week	1.56	1.08-2.24	0.017	1.35	1.13-1.92	0.033
≥ 2 times/week	1.72	1.18-2.49	0.004	3.68	1.21-11.20	0.022
Trend	<i>P</i> =0.004			<i>P</i> =0.001		
Fresh vegetables intake						
<150 g/d	1			1		
150~400 g/d	0.19	0.12-0.31	<0.001	0.57	0.24-1.36	0.207
>400 g/d	0.08	0.04-0.15	<0.001	0.43	0.11-1.69	0.225
Trend	<i>P</i> <0.001			<i>P</i> =0.245		
Fresh fruits intake						
<50 g/d	1			1		
50~100 g/d	0.23	0.16-0.33	<0.001	0.32	0.14-0.71	0.005
>100 g/d	0.07	0.03-0.16	<0.001	0.06	0.01-0.47	0.007
Trend	<i>P</i> <0.001			<i>P</i> <0.001		

a:OR, odds ratio; b:CI, confidence interval

voluntarily participated in this study, including 470 patients diagnosed as gastric cardia adenocarcinoma and 470 controls. All the subjects were farmers living in the nearby counties of Linzhou including 780 male and 160 female. The average age of patients and controls were 57.45 (±6.71) and 57.19 (±6.72) years respectively. There were 467 Han people and 3 Hui people in each group. There was no statistical difference in marital status between the two groups (*P*>0.05). The proportion of high per capita income in controls was significant higher than in cases (*P*=0.001), but the proportion of high degree of education was significant lower in controls than in the cases (*P*<0.001). Demographic characteristics were shown in Table 1.

Univariate analysis

Table 2 showed the results of univariate conditional logistic regression analysis between the putative risk factors and gastric cardia cancer. Smoking and alcohol drinking were proved to be the risk factors of gastric cardia cancer. The relative risk of gastric cardia cancer were increased when combining the active smoking and

Table 5. Multivariable Conditional Logistic Regression Analysis of Risk of GCC

Variables	β	SE (β)	χ^2	ORa	95%CIb	P
High income	-0.35	0.15	5.64	0.71	0.53-0.94	0.018
High degree of education	-1.04	0.39	6.97	0.35	0.16-0.77	0.008
Active smoking	0.66	0.29	5.2	1.94	1.10-3.43	0.023
Alcohol drinking	0.86	0.31	7.81	2.36	1.29-4.31	0.005
Hot food taking	0.71	0.15	21.53	2.03	1.51-2.75	<0.001
Family history of tumor	1.04	0.3	12.43	2.83	1.59-5.05	<0.001
BMI \geq 25	-1	0.21	22.13	0.37	0.24-0.56	<0.001
Fast eating	0.48	0.16	8.51	1.62	1.17-2.23	0.004
Moldy food taking	1.52	0.27	31.33	4.56	2.68-7.77	<0.001
Leftover food taking	0.63	0.18	12.45	1.88	1.32-2.67	<0.001
Fresh vegetables intake	-1.68	0.26	41.11	0.19	0.11-0.31	<0.001
Fresh fruits intake	-1.42	0.27	26.84	0.24	0.14-0.42	<0.001

a: OR, odds ratio; b: CI, confidence interval

passive smoking (OR=3.510). In addition, high income, high degree of education and BMI \geq 25 were belong to protective factors against the cancer gastric cardia cancer, but family history of tumor was significantly associated with an increased risk of gastric cardia cancer.

The relationship between dietary characteristic and gastric cardia cancer were shown in Table 3. Hot food taking, pickled food taking, fried food taking, moldy food taking, leftover food taking and fast eating were all risk factors of gastric cardia cancer, while fresh vegetables and fresh fruits intake were belong to protective factors against the cancer. However, salt taste and irregular meal showed no relation to the risk of gastric cardia cancer.

The effect of dietary factors to the gastric cardia cancer were different according to the stratifying analysis by sex, which was shown in Table 4. Hot food taking, fast eating, pickled food taking and fresh vegetables intake were only observed relating to gastric cardia cancer in male. The association between other dietary factors and gastric cardia cancer in male or female were consistent with the overall analysis.

Multivariable analysis

Based on the results of univariate analysis, multivariable conditional logistic regression analysis was performed and shown in Table 5. All the variables which were associated with gastric cardia cancer ($P<0.05$) simultaneously enter the multivariable regression model using forward stepwise method (Forward: LR). Similarly, active and passive smoking, alcohol drinking, hot food taking, fast eating, moldy food taking, leftover food taking and family history of tumor were significantly associated with an increased risk of gastric cardia cancer ($P<0.05$). On the contrary, high income, high degree of education, fresh vegetables, fresh fruits and high BMI were found to be protective factors against gastric cardia cancer ($P<0.05$).

Discussion

Previous small-scale studies have reported the risk factors of gastric cancer in Linzhou (Sun et al., 2002) and gastric cardia cancer in other areas with high incidence of gastrointestinal cancer in China (Cai et al., 2003), in which the subjects had different occupations and the controls didn't provide the diagnosis by pathological examination in detail. With the increased emphasis on rural issues concerning agriculture, countryside and farmers, we only

chose the farmers living in the countryside of Linzhou in Henan province in this case-control study. Controls were only included if they haven't any digestive system disease including atrophic gastritis, inflammation, hyperplasia, intestinal metaplasia. The selection bias was reduced and the efficiency was increased as much as possible in this study.

We found an increased risk of gastric cardia cancer associated with smoking and alcohol drinking, which is consistent with the meta-analysis between the tobacco and esophageal and gastric cardia adenocarcinoma recently (Tramacere et al., 2011). In our study, alcohol drinking was also identified as a risk factor for gastric cardia cancer. In contrast, there is no significant relationship between the drinking and esophageal and gastric cardia cancer in recent meta-analysis (Tramacere et al., 2012), which might be attributed to the variation of socioeconomic status in different areas and should be verified in further study.

The present study detected the dietary habits including hot food taking, fast eating, moldy food taking and leftover food taking were risk factors for gastric cardia cancer, part of which has been reported in the previous case-control study (Sun et al., 2002; Cai et al., 2003). Epidemiological evidence has supported an association between the risk of developing gastric cancer and the intake of salt and salt-preserved foods (Riboli et al., 2001). We can infer two most likely explanations for the negative association between the intake of sale and irregular meal in this study. Maybe the disease or its precursor stages changes the dietary preferences of the patients, or probably because the living style and dietary habit have been changed through the positive dissemination of the health education knowledge in local areas. With the development of economic in rural areas in China, both the consumption of fresh vegetables and fruits were proved to be protective factors, which was opposite to the report 10 years ago in Linzhou (Sun et al., 2002). Moreover, effects of taking fresh vegetables and fruits against gastric cancer may be mediated by ascorbic acid, heme iron and Selenium, which is consistent with the former epidemiological studies (Hill, 1998; Ward et al., 1999; Cai et al., 2003; Rayman, 2005; Jakszyn et al., 2012). One European large-scale prospective study had also confirmed that greater adherence to a relative Mediterranean diet was associated with a significant reduction in the risk of incident for gastric adenocarcinoma (Buckland et al., 2010).

It is interesting to detect that hot food taking, fast eating, pickled food taking and fresh vegetables intake were only observed relating to gastric cardia cancer in male after stratifying analysis by sex. This phenomenon can explain the high incidence in male, including 390 male and 80 female patients in this study, which was consistent with past studies in China (Cai et al., 2003).

We also observed that high income and high degree of education were protective factors of gastric cardia cancer, which was consistent with the studies more than 10 years ago (Brewster et al., 2000; Sun et al., 2002). Low socio-economic status and poor education were still the key factors on the life style and dietary structure for the rural resident in Linzhou. Previous observational studies support a positive association between BMI and

the risk for esophageal and possibly for gastric cardia cancer (Kubo et al., 2006; Abnet et al., 2008; Corley et al., 2008). However, present study showed high BMI was a protective factor for gastric cardia cancer, which was consistent with the study on North Chinese (Zhang et al., 2003). In addition, the maximum of BMI was 35, and few overweight subjects were found in our study. It might be explained that high BMI only reduced the incidence of gastric cardia cancer within a certain range of BMI. What's more, genetic factor may also be one of main factors influencing gastric cardia cancer in this study. The correlation between the cardia gastric cancer and family history of tumor suggested that genetic predisposition and common dietary habits might contribute to the cardia carcinogenesis (Dhillon et al., 2001; Wen et al., 2010). The migration epidemiology had demonstrated that the incidences for esophageal cancer in the offspring of immigrants who migrated to Shanxi province 108 years ago were the same as native counterparts in Linzhou (Wang et al., 2005).

In conclusion, various complex factors related to gastric cardia cancer interact with each other. We confirmed that unhealthy living habits and unreasonable dietary structure was associated with an increased risk of gastric cardia cancer in the rural areas in Linzhou, with backward economy and low literacy. Therefore, our government should more focus on the development of economic and the health education in local residents.

Acknowledgements

Authors thank the staff working in the Tumor Hospital and government of Linzhou for their help for this study. This study was supported in part by a grant from Soft science plan of Henan Province (122400450034).

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