

Diet and gastric cancer: a case-control study in Fujian Province, China *

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Abstract

AIM To explore the relationship between consumption of fish sauce, other dietary factors, living habits and the risk of gastric cancer.

METHODS From May 1994 to July 1995, a population-based 1:2 case-control study was carried out in high-risk areas of gastric cancer, Changle and Fuqing cities, Fujian Province. Totally 272 cases and 544 age, gender-matched controls were included. Risk state analyses were made by ASRS package.

RESULTS Risk state single-factor analysis indicated that gastric cancer risk rose with high intake of fish sauce (OR=2.57), salted vegetables (OR=1.41), salted/fried fish and small shrimps (OR=1.57), low consumption of fresh vegetables (OR=1.95), fresh citrus fruits (OR = 1.41), other fresh fruits (OR = 1.31), green tea (OR=1.72), exposure to moldy foods (OR=2.32), irregular dinners (OR=5.47) and familial history of malignancy (OR=3.27). No significant relationship was observed between smoking, drinking, salt intake, use of refrigerator and gastric cancer risk. The results of risk state conditional Logistic regression showed that fish sauce, salted dried fish and small shrimps, irregular dinners, familial history of malignancy were included in the best risk set. The summary AOR for the four factors was 75.49%.

CONCLUSION High intake of fish sauce, salted foods, moldy foods, irregular dinners and familial history of malignancy were possible risk factors for gastric cancer, whereas fresh vegetables and fruits, and green tea might have protective effects for gastric cancer.

INTRODUCTION

Changle and Fuqing cities are located in the southeastern part of Fujian Province, China with a high incidence of gastric cancer. However, the causes of gastric cancer still remain unclear. Previous studies indicate that environmental factors may play an important role in the carcinogenesis of gastric cancer, among which, dietary risk factors for gastric cancer were most extensively investigated. Our hypothesis is that the high incidence of gastric cancer may be attributed, to some extent, to some unique dietary habits. Recently a statistically significant relationship between fish sauce consumption, a condiment commonly used by local residents, and the mortality rates from gastric cancer was observed by our ecological study^[1]. The mutagenicity of fish sauce was also reported by experimental studies^[2]. N-nitrosamines can also be detected in fish sauce^[3]. In order to explore further the relationship between consumption of fish sauce and gastric cancer, a population-based 1:2 matched case-control study was carried out from May 1994 to July 1995.

MATERIALS AND METHODS

Selection of cases and controls

This study was conducted in Changle and Fuqing cities with populations around 600 thousands and 1 million, respectively. All cases histologically confirmed or diagnosed by operation from January 1993 to July 1995 were collected from cancer registry and a quick-reporting system from hospitals. Each case was matched by two randomly selected controls who resided in the same village as index case, with same gender, nationality and age (± 3 years). Those who have ever been diagnosed having gastric diseases within the past 3 years were not eligible as controls. Study subjects must have

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resided in the two cities for more than 20 years, and can answer questions clearly.

Investigation

Face to face interviews were made by specially trained interviewers with a structured questionnaire. The items of questionnaire included demographic and socio-economic factors, occupational and medical histories, family occurrence of cancer, use of alcohol and tobacco, and dietary habits. As for dietary habits, we emphasized on the exposure 20 years before. Diet was assessed with a food frequency questionnaire. The subjects were interviewed about the usual frequency of consumption of certain foodstuffs, supplemented with questions about the actual amount consumed per time unit. Then total amount per year was estimated accordingly. The subjects within a matched pair were interviewed by one interviewer.

Statistical analysis

Data were handled by Epi-info. The statistical analyses, including univariate analysis and conditional logistic analysis were done using ASRS software^[4]. In univariate analysis, the best cut-points for exposure levels were searched by automatic or forced adjustment, combination, on the criteria of CPDS and AIC. Those factors, which showed association with the risk of gastric cancer in univariate analysis, were further investigated by conditional logistic analysis of risk states to establish a main-effect model.

RESULTS

Totally 272 pairs were investigated, among which 157 were from Changle City, 115 from Fuqing City; 233 were male and 39 female. The age range for cases was 30-78 years, averaging 58.67 years. No obvious difference in marital status, occupation and education level was observed between cases and controls.

The results of univariate analysis are shown in Table 1. As for dietary habits, consumption of fish sauce, salted vegetables, salted fermented sea products and moldy foods may increase the risk of gastric cancer. However, fresh vegetables, fruits and green tea may have protective effects against gastric cancer. Additionally, irregular dinner and family occurrence of cancer are also risk factors for gastric cancer. No association between the use of alcohol and tobacco, the amount of salt intake, the use of refrigerator and the risk of gastric cancer was observed. To select a possible best subset of risk factors for gastric cancer, conditional logistic analyses of risk states were also made. The results

showed that the best subset of risk factors included fish sauce, irregular dinner, salted fermented sea products and family occurrence of cancer (Table 2). The summary attributable risk for these four risk factors is 75.49%, indicating that these four factors may play an important role in the carcinogenesis of gastric cancer.

Table 1 Results of univariate analysis on the relationship between fish sauce, other factors and the risk of gastric cancer

Factors	Exposure	Case	Control	OR	95%CI
Index of smoking ^a	>10	118	241	1	
	≤10	154	303	1.04	0.95-1.13
Hard distilled spirit	≤20kg/y	265	534	1	
	>20kg/y	7	10	1.41	0.63-3.14
Soft distilled spirit	>25kg/y	13	29	1	
	≤25kg/y	259	515	1.12	0.86-1.47
Wine	≤30kg/y	245	494	1	
	>30kg/y	27	50	1.09	0.89-1.33
Beer	>50 bottle/y	42	106	1	
	≤50 bottle/y	230	438	1.33	0.93-1.88
Green tea	>0.75kg/y	47	144	1	
	≤0.75kg/y	225	400	1.72	1.26-2.36 ^e
Fish sauce	<0.4kg/m	198	475	1	
	≥0.4kg/m	74	69	2.57	1.89-3.50 ^e
Salt ^b	≤0.25kg/m	159	347	1	
	>0.25kg/m	113	197	1.25	0.96-1.63
Moldy foods	No	188	456	1	
	Yes	84	88	2.32	1.73-3.09 ^e
Irregular dinners	<3 times/w	114	434	1	
	≥3 times/w	158	110	5.47	4.22-7.09 ^e
Use of refrigerator	Yes	35	78	1	
	No	237	466	1.13	0.85-1.52
Salted vegetables	<2kg/y	157	358	1	
	≥2kg/y	115	186	1.41	1.09-1.83 ^d
Salted fermented sea foods	<1.5kg/y	144	347	1	
	≥1.5kg/y	128	197	1.57	1.21-2.02 ^e
Citrus fruits-c	>2.5kg/y	55	143	1	
	≤2.5kg/y	217	401	1.41	1.03-1.92 ^d
Other fruits	>2.5kg/y	166	366	1	
	≤2.5kg/y	106	178	1.31	1.01-1.71 ^d
Fresh meat, fish, egg, poultry	>25kg/y	105	238	1	
	≤25kg/y	167	306	1.24	0.95-1.61
Fresh vegetables	>25kg/y	212	475	1	
	≤25kg/y	60	69	1.95	1.41-2.70 ^e
Family occurrence of cancer	No	165	454	1	
	Yes	107	90	3.27	2.48-4.31 ^e

^asmoking index: (amount of smoking^{day} × years of smoking)/age of starting smoking; ^bincluding the salt in fish sauce and soybean sauce; ^cincluding orange, grapefruit, banana; ^d $P < 0.05$; ^e $P < 0.01$.

Table 2 The results of conditional logistic analysis of risk states

Factors	Regression coefficient	Standardized regression coefficient	Adjusted attributable risk ^a
Fish sauce	1.08	3.49	17.81% ^c
Irregular dinners	1.85	8.26	48.93% ^c
Salted sea foods	0.54	2.11	19.69% ^b
Familial history of malignancy	1.19	5.45	27.41% ^c

^aComprehensive attributable risk (CAR) = 75.49%; ^b $P < 0.05$; ^c $P < 0.01$.

DISCUSSION

Fish sauce is one kind of condiments consumed daily by local residents. It is produced by long-term fermentation from several kinds of sea fish. Due to the proteins with amino in the fishes, salted fermented fish products may contain a large amount of important precursors of N-nitroso compounds-amines^[5]. These precursors may react with nitrite in gastric juice to form N-nitroso compounds internally. Deng et al reported that abstracts of fish sauce from Changle have carcinogenicity and mutagenicity after nitration^[2]. The amount of N-nitro compounds increased greatly after nitration, and genotoxins can be detected^[3]. Our ecological study indicated that there was a statistically significant relationship between fish sauce consumption and mortality rates from gastric cancer among 14 counties in Fujian Province^[1]. The results of this study further supported the point that fish sauce consumption may be an important cause for the high incidence of gastric cancer.

Several case-control studies have indicated that long-term use of refrigerators may decrease the risk of gastric cancer^[6-8]. However, in our study, refrigerators were not commonly used by local residents. Even among those users, the history of refrigerator use is very short. Therefore, it is impossible to evaluate the role of refrigerator use in the etiology of gastric cancer. However, the deficiency of refrigerator indicated that the consumption of salted foods was very common. Especially in the study area which is located on seaboard, the consumption of salted or fermented sea foodstuffs is very common. In our study, consumption of salted foodstuffs, especially of salted fermented sea products was found to increase the risk of gastric cancer. This is in accordance with the results of Buiatti *et al*^[7]. Additionally, our study indicated that irregular dinner may be one of etiological factors for gastric cancer. This finding supported the results of our previous ecological study^[1]. Irregular dinner may

cause injuries of gastric mucosa and promote the effects of carcinogens. A prospective study showed that those with familial history of malignancy, especially gastric cancer, have a higher risk of gastric cancer^[9]. This is in agreement with our study results. In our study, fresh vegetables showed a protective effect against gastric cancer. This is also true for citrus fruits and other fruits. Their protective effects may be attributed to the vitamin C, which may interrupt the internal formation of N-nitroso compounds. Some studies reported that only consumption of raw vegetables had a protective effect^[6,7]. However, in our study area, residents do not have such a habit. There were conflicting views on the relationship between the use of alcohol and tobacco and the risk of gastric cancer^[6,7,9,10]. In our study, no association was observed between the use of alcohol, tobacco and the gastric cancer risk. No interaction between these two factors was found either.

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