RESEARCH COMMUNICATION

Lifestyle-Related Risk Factors for Stomach Cancer in Northeast Thailand

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Abstract

Background: Stomach cancer is not common in Thailand but the life styles of the Thai population are changing to become more Western so that information for planning control programme of stomach cancer is necessary. The highest incidence rates of this neoplasm are found in Eastern Asia, ranging from age-standardized rates of $95.5/10^5$ (men) and $40.1/10^5$ (women) in Yamagata, Japan to $4.1/10^5$ (men) and $2.1/10^5$ (women) in Khon Kaen, Northeast of Thailand. In Thailand, the estimated age-standardized incidence rates in 1993, 1996 were $4.9/10^5$, $4.1/10^5$ in men and $3.0/10^5$, $2.6/10^5$ in women. Risk factors for stomach cancer in Thai population are unclear, but possibly include low intake of vegetables and fruits, alcohol drinking, tobacco smoking and high intake of salt. Objective: To investigate various aspects of dietary factors, smoking, and alcohol drinking in determining risk of stomach cancer in Thai population. Methods: A case-control study was conducted in Khon Kaen, Thailand during 2002-2006, to study the role of these factors in stomach cancer. 101 stomach cancer cases and 202 matched controls (case : control = 1:2) by sex, age (± 3 years) and region were recruited from Srinagarind Hospital and Khon Kaen Regional Hospital, in Khon Kaen Province. All of cases were histologically confirmed. Controls had a variety of diseases, the main ones being disease of the eye. Information on dietary habits, alcohol drinking and smoking were collected by a structured questionnaire, blood samples were collected for further study. Results: The distribution of the general characteristics by case-control status, the distribution of age and sex were similar in cases and controls. In the final analysis, the factors that found to be higher risk but not statistically significant were long-term filter cigarette smoking (OR=1.9, 95%CI: 0.85-4.50), long-term alcohol consumption (OR=1.2, 95%CI: 0.51-2.60) and low intake of vegetables and fruits (OR=1.2, 95%CI: 0.74-1.96). A high intake of vegetable oil (OR=4.5, 95%CI: 1.00.-20.17) was found to be associated with increased risk, and similar tendencies were noted for pork oil (OR=1.4, 95%CI: 0.63-3.01) and jeaw prik (mainly chilly with plara broth) (OR=1.2, 95%CI: 0 .76- 2.01). Conclusion: Our study confirmed protective effects of a high intake of fruits and vegetables against stomach cancer development and showed a high intake of sauces to increase risk of stomach cancer as in other countries in Asia.

Key Words: Case-control - stomach cancer - risk factors - northeast Thailand

Introduction

Stomach cancer is more common cancer in Thai men than Thai women. The life styles of Thai population are changing as Western styles; therefore it is necessary to find out the information for planning control programmed of stomach cancer. The estimated age-standardized incidence rate of stomach cancer in Thailand were 4.9 per 100,000 for males and 3.0 per 100,000 for females. Chiang Mai had the highest incidence rate were 7.9 per 100,000 and 5.2 per 100,000 both males and females

followed by Lampang ASR. were 7.5 and 4.6 per 100,000 in males and females. The lowest rates are in Songkhla ASR. were 2.0 and 1.4 per 100,000 in males and females respectively (Sriplung et al., 2003). The highest incidence rates were found in Eastern Asia, ranging from age standardized rates of $95.5/10^5$ (men) and $40.1/10^5$ (women) in Yamagata, Japan to $4.1/10^5$ (men) and $2.1/10^5$ (women) in Khon Kaen, Northeast of Thailand (Parkin et al., 1997, Sriamporn et al., 2002, Suwanrungruang et al., 2006). In Thailand, the estimated age-standardized incidence rate in 1993/1996 was $4.9/10^5$, $4.1/10^5$ in men

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and $3.0/10^5$, $2.6/10^5$ in women (Deerasamee et al., 1999 ; Sriplung et al., 2003). Risk factors for stomach cancer in Thai population are unclear, but possibly including low intake of vegetables and fruits, alcohol drinking, tobacco smoking and high intake of salt.

The risk of developing cancer in several organs appears to be associated with a dietary factors that is low of fiber and high of calories, protein, fat, and history of family cancer (Huang et al.,1999; Huang et al., 2004). Risk factors for stomach cancer include low intake of vegetable, fruits, alcohol drinking, tobacco smoking and high intake of salt (WCRF, 1997).

As part of a multi-centre study of 'The epidemiological study of host and environmental factors for stomach and colorectal cancers in Southeast Asian Countries', we here examined possible determinants of stomach cancer in the population of Northeast Thailand as a hospital-based case-control study of patients who came to get treatment at Srinagarind Hospital and Khon Kaen Regional Hospital in Khon Kaen, Thailand.

Materials and Methods

Subjects

101 new stomach cancer cases and 202 controls were recruited from Srinagarind Hospital and Khon Kaen Regional Hospital in Khon Kaen Province, Thailand. All of cases were from Northeast. All of stomach cases were not specified sub site 67.33%, 15.84 % antrum, and 13.86% cardia respectively, all of cases were histological confirmed; the most common was adenocarcinoma 69.31%. Stomach cancer cases and controls were recruited in the same period and each case matched by sex, age (± 3 years) and regional. All subjects gave informed consent to their participation in the study. Controls had a variety of diseases, the main ones being disease of the eye. All subjects were interviewed by trained interviewer using a

Table 1. The Distribution of General Characteristics of Stomach Cancer Cases and Controls

Characteristic	Cases (n = 101)	Controls (n = 202)
Sex, n (%)[a]		
Male	57 (56.44)	114 (56.44)
Female	44 (43.56)	88 (43.56)
Age group, n (%)[a]		
≤39	16 (15.84)	29 (14.36)
40-49	23 (22.77)	51 (25.25)
50-59	30 (29.70)	54 (26.73)
60-69	25 (24.75)	59 (29.21)
≥ 70	7 (6.93)	9 (4.46)
Median age y (range)[a]	53(28–70)	53(29–73)
BMI ≥ 25 k/m2, n (%)	3(3.03)	54 (26.73)
Education level, n (%)[a]		
≤ high school	77 (76.24)	171 (84.65)
> high school	24 (23.76)	31 (15.35)
Occupation activity, n (%)		
Heavy labour work	73 (73.00)	150 (74.26)
Moderate work (standing)	14 (14.00)	38 (18.81)
Light work (sitting)	13 (13.00)	14 (6.93)
Income (Baht)		
Median (range)	3000 (333-60000)	3000 (300-60000)

structured questionnaire, the questionnaire composed two sections; demographic socioeconomic status smoking history and food frequency structured by meals.

Statistical methods

The association between stomach cancer and some possible risk factors were measured by using odds ratio (OR) and 95% confidence intervals (95% CI) derived from conditional logistic regression to account for the match of cases and controls, all variables were categorized based on percentiles of the distribution in controls.

Body mass index (BMI) was computed as weight (kg) divided by the square of height (m2) which are categorized into two levels (< 25, normal weight and ≥ 25; non-normal; 25 to 29, overweight plus ≥ 30, obese)

Occupation activity is categorized into 3 levels as heavy labour work, moderate work and light work based on working types; heavy labour workers are persons who are labour worker in farms, garden and building constructor, etc. moderate workers are persons who are mostly work by standing or sitting but use power such as sale man, hair stylist, servant and policeman etc. and light workers are persons who are mostly work by sitting and management such as manager and clerk, etc.

Exercises are categorized into two levels (exercise and non-exercise). Exerciser is defined as those who play sports at least 3 times a week, others are non-exercisers Smoking analysis, there were categorized as smokers and nonsmokers Smokers included those who smoked filtered, unfiltered cigarettes and yamuan (a home-made cheroot). Duration of smoking, and average number of cigarettes per year were computed based on all smoking periods reported and dichotomized on the median of the controls. Average number of cigarette was calculated as annual cigarettes smoked (filtered and unfiltered) plus 1.5 times annual yamuan smoked. The 1.5 correction factor was used to allow for the longer size of yamuan compared with the regular cigarettes. The amount of cigarettes was categorized based on the 50th percentile of the controls and dichotomized into low and high levels.

Alcohol drinking, there were two categories for alcohol drinking: drinkers and nondrinkers. Drinkers, was defined as who have consumed at least one type of all alcoholic beverages (beer, sato, white alcohol, mekong and other whiskies) and consumed within range of ever day to once a month . Those who did not drink or have consumed all alcoholic beverages with frequently less than one time a month were categorized as nondrinkers.

Dietary intake within a previous year (vegetables, fruits, fish/shellfish: fresh/sea water, meat and fried meat), there were categorized two levels as low and high. Frequencies of each dietary intake, and an amount of intake per year were computed based on each type of dietary intakes reported and dichotomized on the median of controls.

Results

In this matched case-control study, the distributions of age, sex and residence were the same in cases and controls. There were 135 males and 118 females, median

Table 2. Smoking Habit and Alcohol Drinking (Males Only)

Type (frequency per yr)	Cases (n=101)	Controls (n=202)	OR$_c$ (95% CI)	OR$_{adj}$ (95% CI)
Smoking				
Duration and type of cigarette, n^c (%)				
Nonsmokers	5 (8.8)	22 (19.3)	1.0	1.0
Filtered (>20 years)	19 (33.9)	30 (26.3)	1.4 (0.71-2.88)	1.5 (0.73-3.12)
Unfiltered (> 7 years)	1 (2.6)	1 (1.2)	2.3 (0.13-37.86)	1.7 (0.07-37.72)
Amount of cigarettes per yr,n^c (%)				
Nonsmokers	5 (8.9)	22 (19.3)	1.0	1.0
Low (1-3650)	20 (35.7)	53 (46.5)	1.3 (0.46-3.77)	1.7 (0.54-5.48)
High (>3650)	31 (55.4)	39 (34.2)	2.7 (0.97-7.94)	3.4 (1.04-10.92)
			P for trend: 0.01	*P for trend: 0.01*
Type of cigarette, n^c (%)				
Filtered	12 (92.3)	20 (95.2)	1.0	1.0
Unfiltered	1 (7.7)	1 (4.8)	1.7 (0.09-30.62)	1.2 (0.05-25.59)
Alcohol drinking, n^c (%)				
Non drinker	22 (38.6)	53 (46.1)	1.0	1.0
Ever drinker	35 (61.4)	62 (53.9)	1.3 (0.69-2.55)	1.4 (0.68-2.66)
Duration				
Nondrinkers	22 (38.6)	53 (46.5)	1.0	1.0
Short (1-21 years)	17 (29.8)	31 (27.2)	1.3 (0.61-2.87)	1.2 (0.48-2.85)
Long (> 21 years)	18 (31.6)	30 (26.3)	1.4 (0.67-3.13)	1.5 (0.67-3.29)

Stomach cancer; OR, odds ratio; 95% CI, 95% confidence interval.^{c}Missing cases, Adjusted for age

age is 53 year. The majority were educated lower than high school. Most of subjects were hard labour workers, the median income per month for both cases and controls are similar (3,000 baht per month) (Table 1).

Smoking habits in male cases and controls, and the odds ratio (OR) were found to be associated with an increased risk but not statistically significant (OR=1.2, 95%CI: 0.74-1.95). There was strong association between high consumptions of cigarettes smoking and stomach cancer with statistically significant (OR=3.4, 95%CI: 1.04-10.92, P-value 0.01). There was a higher risk of stomach cancer but not statistically significant in smoker with long-term of filtered cigarettes (OR= 1.5, 95%CI: 0.73-3.12). There was no evidence of a dose-response effect with respect to duration of smoking. Alcohol consumption every day and consumption period were increased risk of stomach cancer but not statistically significant (OR=1.2,

95%CI: 0.48-2.85 (short period), and OR=1.5, 95%CI: 0.67-3.29 (long period)) (Table 2).

Low consumption of vegetables and fruits are associated with an increased risk of stomach cancer (OR=1.2, 95%CI: 0.72-2.07) but not statistically significant. This study showed increased consumption of meat and grilled meat are protective factors (OR=0.6, 95%CI: 0.35-1.02 and OR=0.6, 95%CI: 0.39-1.17) (Table 3).

Preference for spicy food was associated with stomach cancer risk in this population. This study found that a high intake of vegetable oil was high risk for stomach cancer (OR=5.4, 95%CI: 1.05-27.39, P-value 0.03), pork oil (OR=1.4, 95%CI: 0.58-3.48) and Jeaw Prik (mainly chilly with plara broth) (OR=1.2, 95%CI: 0.76- 2.18) were found to be associated with an increased risk but not statistically significant . For red and dry chilli were protective factors

Table 3. Amount of Food Intake Associated with Stomach Cancer

Types (frequency per yr)	Cases (n=101)	Controls (n=202)	OR$_c$ (95% CI)	OR$_{adj}$ (95% CI)
Vegetable/Fruits, n^c (%)				
High (535-1098)	45 (45.0)	100 (49.7)	1.0	1.0
Low (234-534)	55 (55.0)	101 (50.3)	1.2 (0.74-1.96)	1.2 (0.72-2.07)
Vegetable Only, n^c (%)				
High (295-606)	46 (45.5)	98 (48.5)	1.0	1.0
Low (120-294)	55 (54.5)	104 (51.5)	1.1 (0.6-1.8)	1.19 (0.68-1.90)
Fruit Only, n^c (%)				
High (247-588)	44 (44.0)	94 (46.8)	1.0	1.0
Low (72-246)	56 (56.0)	107 (53.2)	1.1 (0.68-1.81)	1.1 (0.66-1.83)
Fish/Shellfish:Fresh/Seawater,n^c (%)				
High (420-1459)	49 (49.0)	101 (50.0)	1.0	1.0
Low (30-419)	51 (51.0)	101 (50.0)	1.0 (0.64–1.68)	1.0 (0.62-1.66)
Meat, n^c (%)				
Low (0-241)	62 (62.0)	102 (50.5)	1.0	1.0
High (242-858)	38 (38.0)	100 (49.5)	0.6 (0.38-1.02)	0.6 (0.35-1.02)
Grill Meat n^c (%)				
Low (0-154)	62 (62.0)	102 (50.5)	1.0	1.0
High (155-674)	38 (38.0)	100 (49.5)	0.7 (0.45–1.19)	0.6 (0.39–1.17)

Stomach cancer; OR, odds ratio; 95% CI, 95% confidence interval. ^{a}Odds ratio from a conditional logistic regression model including the matching factors and the individual characteristic listed. ^{c}Missing cases

Table 4. Cooking and Food Preparation by Case-control Status

Type of Food Preparation	Cases (n=101)	Controls (n=202)	OR$_c$ (95% CI)	OR$_{adj}$ (95% CI)
Vegetable oil	98 (98.0)	185 (91.5)	4.5 (1.00-20.17) *P for Trend 0.03*	5.4 (1.05-27.39) *P for Trend 0.02*
Pork oil	12 (12.0)	18 (8.9)	1.4 (0.63-3.01)	1.4 (0.58-3.48)
Coconut oil	28 (28.0)	55 (27.3)	1.0 (0.60-1.77)	1.0 (0.59-1.77)
Green chilli	60 (60.0)	119 (58.9)	1.0 (0.64-1.70)	1.0 (0.63-1.71)
Red chilli	85 (85.0)	182 (90.1)	0.6 (0.32-1.27)	0.6 (0.28-1.31)
Dry chilli	70 (70.0)	158 (78.2)	0.6 (0.38-1.16)	0.6 (0.34-1.20)
Jeaw prik (mainly chilly with plara broth)	49 (49.5)	89 (44.1)	1.2 (0.76-2.01)	1.2 (0.76-2.18)
Jeaw prik (no plara broth, mainly chilli with fish sauce)	29 (29.3)	74 (36.6)	0.7 (0.42-1.20)	0.6 (0.35-1.15)
Sea salt	12 (11.9)	14 (6.9)	2.2 (0.95-5.27) *P for Trend 0.05*	2.1 (0.89-5.22) *P for Trend 0.001*

*Adjusted for age

of a high intake (OR=0.6,95%CI: 0.28-1.31, OR=0.6, 95%CI: 0.34-1.20) but not statistically significant. A high consumption of sea salt was high risk (OR=2.1, 95%CI: 0.89-5.22) (Table 4).

Family history of cancer was strong association with an increased risk for stomach cancer (OR=2.3, 95%CI: 1.32-3.94, P-value 0.00). Both of cases and controls BMI were lower than 25 k/m2 ; 81.06%, median 21.3 then BMI more than 25 k/m2 was a protective factors same as exercise was a protective factors but not statistically significant (OR=0.7, 95% CI: 0.33-1.33) (Table 5).

Discussion

For this study we found stomach cancer risks were associated with many factors such as; high of tobacco smoking, alcohol drinking, vegetable oil, pork oil, Jaew Prik with plara's broth, sea salt will increased risk of stomach cancer.

In men, tobacco smoking may be related to the risk of stomach cancer, the higher risk of stomach cancer among low and high amount of cigarettes; OR=3.4, trend P-value 0.01. and alcohol drinking was increased risk (Chow et al.,1999; Nishio et al., 2006; Sjodahl et al.,2007).

The role of different dietary factors is promoting and preventing stomach cancer have resulted in broad consensus that fresh fruits and vegetables are protective factors, while preserved, salt and pickled foods enhance risk (WCRF, 1997) same as previous study (Sriamporn et al., 2002). High consumption of meat and grilled meat were protective factors, contrast other study cause of high and low consumption are not difference when compare with other study. Most of spice and food plant in Thailand may have chemopreventive activities and may be reduced

incidence of stomach cancer (Bhamarapravati et al., 2003; Suwanrungruang et al., 2006) same as this study, we found that chillis are protective factors; OR=0.6 but not statistically significant. The salt intake and consumption of fermented foods, salt intake especially sea salt has a strong associated an increased risk for stomach cancer after adjusted with age groups; OR=3.6, tend P-value 0.00 (Hoshiyama and Sasaba, 1992; Nazario et al.,1993; Lee et al., 1995; WCRF,1997; Sriamporn et al., 2002; Sun et al., 2002; Kurosawa et al.,2006)

In summary, the present case-control study of stomach cancer confirmed cigarette smoking habit and high number of cigarettes, alcohol drinking and period of drunk, low consumption of fruits and vegetables were risk factors of stomach cancer in Northeast, Thailand. High intake of oils and salt especially sea salt and relative of first degree family history of cancer were found to be associated with increased risk (Huang et al.,1999; Huang et al., 2004; Barber et al.,2006).

The majority of the causes of cancer; such as tobacco smoking, alcohol drinking, fat, salt, obesity etc. are associated with life-style, that is personal choices and not environmental causes.

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Table 5. Characteristics Associated with Stomach Cancer

Characteristics	Cases (n=101)	Controls (n=202)	OR$_c$ (95% CI)	OR$_{adj}$ (95% CI)
Family history of cancer, n (%)	39 (39.0)	45 (22.3)	2.2[b] (1.31–3.78) *P for Trend 0.001*	2.3[b] (1.32–3.94)* *P for Trend 0.001*
BMI ≥ 25 k/m², n (%)	3 (3.03)	54 (26.7)	0.1[b] (0.02–0.29) *P for Trend 0.001*	0.1[b] (0.02–0.29)* *P for Trend 0.001*
Exercise , n (%)	17 (16.8)	25 (12.4)	0.7 (0.35–1.36)	0.7 (0.33–1.33)**

Stomach cancer; ORc, Crude Odd Ratio; ORadj, Adjusted Odd Ratio for *age,**sex. 95% CI, 95% confidence interval. [a]Odds ratio from a conditional logistic regression model including the matching factors and the individual characteristic listed. [c]Missing cases

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