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ORIGINAL ARTICLE

Dietary Habits, Demographical, and Socio-economical Risk Factors of the Newly Diagnosed Gastric Cancers in the Eastern Anatolia Region of Turkey: An Endemic Upper Gastrointestinal Cancer Region

Dogan Nasır Binici · Timur Koca · Hakan Dursun

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Abstract The Eastern Anatolia Region of Turkey is an endemic upper gastrointestinal (esophageal and gastric) cancer region, and the incidence of these cancers are still increasing in the region. We investigated demographic features, dietary habits, and some possible etiologic factors for this high prevalence. Special attention was given to the relationship between consumption of boiled yellow butter and the occurrence of gastric cancer. Age, sex, residential area, socio-economical status, educational status, vegetable and fruit consumption, alcohol and tobacco use, tea consumption, boiled butter usage, cooking and storage methods of the patients with gastric cancer and controls were investigated in East Anatolian Regional Erzurum State Hospital. *Helicobacter pylori* infection for gastric cancer risk was not studied. Fruit, yellow-green vegetables, boiled butter, and breads baked by animal manure consumptions and no refrigeration are found to be statistically significant etiologic factors for gastric carcinogenesis. Dietary habits might be risk factors for gastric carcinogenesis among East Anatolian population. Some regional differences in food processing and preparation also seem to play a role in gastric carcinogenesis.

D. N. Binici
Department of Internal Medicine, State Hospital, 25200 Erzurum, Turkey

T. Koca
Department of Radiation Oncology, State Hospital, 25200 Erzurum, Turkey

H. Dursun (✉)
Department of Gastroenterology, State Hospital, 25200 Erzurum, Turkey
e-mail: hadursun@hotmail.com

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Introduction

Gastric tumors are a frequent type of tumors all around the world and are an important health problem because they are still the second cause of cancer-related deaths [1, 2]. In general, the man-to-woman ratio is 2:1 [3–5]. When all cancer types are considered, upper gastrointestinal tract cancers are the most common cause of mortality and morbidity at the East Anatolia Region of Turkey. Upper gastrointestinal tract cancer incidence in eastern Turkey is still on the rise and the mortality rate has declined little over the past several decades [6–8]. Some epidemiological observational studies showed a correlation between socio-economical status and gastric cancer risk but others did not [9–11]. It is observed that *Helicobacter pylori* and some ecological risk factors especially residential area, dietary habits, food storage, and cooking methods, are also important in the etio-pathogenesis of stomach cancer [12–15]. The aim of this study is to investigate demographical and socio-economical characteristics of the patients as well as ecological risk factors, especially regional food preparation and dietary habits of the patients with gastric cancer, which is known endemically at the East Anatolia Region of Turkey. The association between *Helicobacter pylori* infection and gastric cancer was not included to study.

Patients and Methods

Our study included a total of 188 patients referred to our regional hospital with histologically proven stomach

cancer after upper gastrointestinal fiberoptic endoscopy. The control group was selected from other clinics and the Cancer Surveillance Center of our hospital. The control group consisted of 188 patients with no cancer or gastrointestinal disease. They were matched for age, sex, and area of residence. For all patients, clinical and laboratory evaluation, endoscopic examination, and histopathological examination were performed. The patients and/or their families and control subjects were contacted by the same researchers carrying out the study and the subject's background was completed. The statistical analyses were performed by Fisher' exact test.

Age, sex, residential area, socio-economical status, educational status, refrigerator ownership of the patients, and controls were determined. Income group: Socio-economic status are divided according to gross national income (GNI) per capita, using the World Bank 2007 report. The groups are: low income ($935–3,705/year), high or medium ($3,706 or more per year).

The interrogation of dietary habits, yellow-green vegetable consumption, was quantified on a four-grade scale. Scores were assigned as follows: 3, orderly daily consumption; 2, once a week; 1, 1–3 times a month; 0, once a month or less. The same scale was used to evaluate fruit consumption. The factor of smoking habits was divided into three categories (heavy smoker: one or more pack per day, light smoker: less than one pack per day, and non-smoker). Tea consumption of the subjects was divided into two groups as six cups or more a day and less than six cups a day. Data was recorded on the frequency of animal manure usage (which is regionally used as a fuel for baking foods and breads), boiled butter consumption for cooking, and refrigeration of the cooked meals.

Localization of the gastric cancer (corpus/fundus/cardia, antrum, and diffuse infiltration) and histopathological type of the tumor according to Lauren Classification (diffuse and intestinal) was also determined.

Results

There were 108 men (57%) and 80 women (43%) patients with histopathologically proven stomach cancer of mean (s.d.) age 60.8 (median 61, range 21–92) years. The control group included the same number of subjects. The median age of the control group was 58 (range 30–91). Characteristics of the patients and controls are shown in Table 1. The peak incidence of stomach cancer was during the sixth decade. In the patient group, the male-to-female ratio was 1.35:1.

When socio-economic status was taken into account, 60% of the patients and 64% of the controls were in low

Table 1 Patient characteristics

Characteristics	Patients	%	Control group	%	*P*-value[b]
Age (year)					
<65	115	61	109	58	
≥65	73	39	79	42	
Sex					
Female	80	43	81	43	
Male	108	57	107	57	
Residential area					
Rural	140	74	135	72	
Urban	48	26	53	28	NS
Socioeconomic status					
Low	113	60	121	64	
High or medium	75	40	67	36	NS
Fruit consumption[a]					
3	22	12	35	19	
2	36	19	57	30	
1	85	45	72	38	
0	45	24	24	13	<0.0001
Yellow-green vegetable consumption[a]					
3	17	9	28	15	
2	48	26	65	35	
1	72	38	60	32	
0	51	27	35	18	<0.0001
Alcohol use					
Yes	8	4	12	6	
No	180	96	176	94	NS
Tobacco use					
Heavy smoker	63	34	71	38	
Light smoker	41	22	48	26	
Non-smoker	84	44	69	36	NS
Tea consumption (in a day)					
Up to six cups	60	32	67	36	
More than six cups	128	68	121	64	NS
Boiled-butter usage					
Yes	118	63	86	46	
No	70	37	102	54	<0.001
Bread baked by animal manure					
Yes	110	59	89	47	
No	78	41	99	53	<0.039
Educational status					
University	23	12	31	16	
Medium or high school	41	22	36	19	
Elementary school	72	38	63	34	
No education	52	28	58	31	NS
Refrigeration owners					
Yes	70	37	137	73	
No	118	63	51	27	<0.0001

[a]Yellow-green vegetable and fruit-consumption scores: 3, orderly daily consumption; 2, once a week; 1, 1–3 times a month; 0, once a month or less

[b]Calculated by Fisher's exact test

socio-economical status. There was no difference between patients and controls.

When patients were asked about dietary habits, food storage, and cooking methods; yellow-green vegetable consumption was low and, 63% of the patients were using boiled butter for cooking, 59% of the patients were baking their foods and breads by burning animal manure. Only 37% of the patients owned a refrigerator.

In contrast to the patient group, yellow-green vegetable consumption was high in the control group ($P < 0.0001$). Forty-six percent of the controls were using boiled butter in cooking ($P < 0.001$) and 47% of the controls were using animal manure for baking ($P < 0.039$). Refrigeration ownership percentage was high as 73% in the control group ($P < 0.0001$). Fruit consumption frequency was also significantly different between the two groups ($P < 0.0001$).

Tea consumption was more than six cups a day in the 68% of patients and 64% of controls. There was no difference between two groups. But as a note, people living in this region generally drink very hot tea, and instead of stirring sugar in the tea, there is a common habit of biting sugar before each swallow, a special drinking method unique to the region.

Because of religion, alcoholic beverage consumption of the subjects was low and there was no difference between the two groups. Fifty-six percent of the patients and 64% of the controls were smokers. There was no statistical difference between smoking of the patients and controls.

Seventy-four percent of the patients were living at the rural area and 26% at the urban area. Patients were lately referred to health centers. This resulted from predomination of the low socio-economical status and low educational level.

According to Lauren Classification, histopathologic type of the gastric tumors was as follows: 26 were of diffuse type, 149 of intestinal type, and 13 were undetermined [3]. Localization of the gastric tumors was: 118 in the corpus-fundus and gastric cardia, 45 in the antrum, and 25 were of whole-stomach type of cancer. Histopathological types and locations of the gastric tumors are shown in Table 2.

Table 2 Tumor characteristics

Localization and histopathological types of the tumors	Frequency	%
Localization of the gastric tumors		
Corpus-fundus and gastric cardia	118	63
Antrum	45	24
Whole stomach	25	13
Histopathological type (Lauren Classification)		
Diffuse	26	14
Intestinal	149	79
Undetermined	13	7

Discussion

Adenocarcinoma of the stomach is the second most common malignancy worldwide. There has been an ominous worldwide increase in the endemic proximal form of gastric cancer, notwithstanding methodological problems in correctly identifying the tumor's primary location within the stomach as distinct from the distal esophagus, another important anatomic site with increasing incidence of upper gastrointestinal tract cancer [1, 16, 17].

In gastric carcinogenesis, diet is a major determinant [14, 18–20]. Rather than only one kind of agent, factors like dietary habits, consumption frequency, amount of the etiologically important agents, traditional food-preparation techniques, and storage methods, all play major roles in the etiology of gastric cancer. Excessive salt consumption is also a confirmed factor. Excessive consumption of fish and other seafood plays the lead in the gastric cancer etiology in Japan and other Far-East countries. Lower consumption of fresh fruits and vegetables are other important etiologic factors. Frequent salted and burned-fish consumption is an important reason in Iceland, the country with highest gastric cancer incidence in Europe [5].

There is a correlation between upper gastrointestinal tract tumors and geographical differences. The highest rate is observed in East Asia, where the age-adjusted rate in men is more than 40 per 100,000. The incidence rates in Japanese and Chinese men are approximately 35 per 100,000. By contrast, North America, Northern Europe, Africa, and Southeast Asia have lower gastric-cancer incidences. The incidence in Japan is 10-fold higher than South-Asian countries and 8.5-fold higher than in North America. In all countries, the incidence is higher in men than in women. The worldwide ratio of gastric cancers in all other cancer types is 12.3% for men and 7.5% for women [5].

It is striking that upper gastrointestinal cancers are in a high-ratio in our region [6, 8]. Because of the environment, dietary habits, and different baking and cooking methods, the East Anatolian Region is a relatively isolated area in Turkey. People living in this area are boiling their butter for long storage. This is a cheaper storage method unique to this region. Especially in the rural area of this region refrigeration for food storage is poor. Among the long winter residents are still using this butter for food preparation. Currently there is no literature about this kind of butter consumption. We named it "boiled yellow butter." In our center, another investigation is already ongoing for this kind of butter usage.

In our region, people use tandır for baking their breads, an oven made in a hole in the earth. Fuel for the tandır is animal manure. During baking, the breads inside the tandır are directly exposed to animal manure fumes. This brings

to mind that tandır bakery is an important etiologic agent for gastric carcinogenesis. This also needs further investigation.

Dietary factors and improvement in food storage (refrigeration decreases turnover of nitrosamines to nitrites) caused a significant decline in the worldwide prevalence of gastric cancers. But in developing countries, these are still major causes of the higher incidence rates [15, 18, 21]. The consumption of salted and drained foods is a result of the lower economical status due to inadequate refrigeration storage. In recent years, increased transport of fruits and vegetables and usage of refrigeration for storage has decreased gastric cancer incidence in USA [21, 22].

Upland Eastern Anatolia is a mountainous region. Corella et al. and Palmeiro and colleagues reported that gastric cancer incidence is higher in mountainous sites than coast sites in Spain [10, 23]. Because of the altitude and the long and cold winters, vegetable and fruit production and transport is rare in East Anatolia, also socio-economical status of this region is lower than the other regions of Turkey. These may be the reasons for the etiologically important lower consumption.

In the regions with higher consumption of citrus fruits and fresh vegetables, gastric cancer incidence is lower [18, 19, 24]. High dietary nitrite level is a risk factor for gastric cancers except cardia involvement, on the contrary, vegetal nutrition lowers the risk [25].

A meta-analysis from France suggests a risk of stomach cancer among smokers compared to non-smokers. According to cohort studies in this article, smoking carries a 1.5- to 2.5-fold relative risk for gastric cancer [26]. In another meta-analysis, smoking was considered as the most important risk factor for gastric cancer [27]. Alcohol consumption is also a probable etiologic agent for digestive tract cancers [28, 29]. However, due to Islamic religion, alcohol consumption is not common in Turkey, especially in our region. Also low socio-economic level of the region is the cause of this lower consumption. In our study, we did not find any statistically difference for smoking and alcohol consumption between the two groups.

Türkdoğan et al. reported an endemic upper gastrointestinal cancer region in Van [6, 8], but gastric cancer incidence is also high in the other cities of this region, especially cities in the north. Derakhshan et al. reported right-side predominance for cardia cancers in NW Iran, but we did not find any localization predominance in our series [30].

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