

Original Article

Geographical distribution of stomach cancer related to heavy metals in Kurdistan, Iran

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ABSTRACT

Aims: The aim of this study was to investigate the geographical pattern of stomach cancer and its probable link to heavy metal concentration high-risk area of Kurdistan, Iran.

Materials and Methods: This descriptive-analytical study analyzed the deaths due to cancer over a period of 2006-2010. The data were collected from health deputy of Kurdistan province. Spatial distribution map of cancer was prepared using geographic information system software. Finally, the distribution map of heavy metals that could be related to stomach cancer was provided.

Results: The spatial distribution maps of stomach cancer mortality shows that the highest mortality rate for the stomach cancer was identified in Divandareh, Bijar and Saghez cites. These cities have shown high concentration of heavy metals. Overlaying the map of stomach cancer via distribution of heavy metals in mineral deposits shows that lead, arsenic and antimony concentration in the city were higher density and can lead to stomach cancer.

Conclusions: This study showed that the death rate related to cancer in men and rural area was higher than women and urban area. In addition, the statistical analysis showed a high correlation between gastric cancer and living in the area with mineral deposit of lead, arsenic and antimony.

Key words: Heavy metals, Kurdistan province, medical geography, stomach cancer

INTRODUCTION

The medical geography refers to studying geographical factors that will affect human health and disease.^[1] Ho defines that the medical geography is related to spreading certain diseases in certain geographic areas based on the geographical characteristics.^[2] In the developing countries, the noncommunicable diseases can quickly replace with traditional diseases including infectious diseases and malnutrition that can lead to disability and premature mortality.^[3] So, the cancer epidemic attitude is spreading awareness of cancer consequence for community and the

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control principles against this form of the disease.^[4,5] In the next decade, cancer will be one of the main causes of disease burden in the world. The expected new cases of the disease will increase to 15 million in 2020, and about 60% of these cases will occur in developing countries.^[6] In comparison with other types of cancer, the early symptoms of stomach cancer are vague and unknown.^[7] Nowadays, this cancer is a serious problem that threatening the health of the global population.^[8] About 10% of cancer in worldwide are related to gastric cancer, and more than 870,000 new cases are reported in the year.

In addition, more than 650,000 people are dying from cancer in the world and more than 70% of cancer deaths are occurred in developing countries.^[9,10] Among this, about 60% of all cases occur in developing countries, particularly in East Asia.^[11] The ministry of health was reported that the gastric adenocarcinoma is the most deadly form of cancer in Iran.^[12] The cancer incidence in other countries is 0.1%, compared to America 15 times greater and 12 times lower than in Western Europe. So, it is an important subject that should be noticed in Iran.^[13] Environmental and climatic conditions of different areas can promote the occurrence and prevalence of certain diseases. More than 90% of cancers are attributed to biological agents in the environment including chemical and physical environmental factors and social and behavioral factors.^[9] This study aimed to assess the geographic and demographic patterns of mortality due to stomach cancer in Kurdistan, Iran, and its spatial analysis of heavy metals (Lead, Arsenic and Antimony) by geographic information system (GIS).

MATERIALS AND METHODS

This epidemiological study was conducted in Kurdistan, Iran, the area shown in Figure 1. The death data related to stomach cancer during 2007-2011 were collected of local health department and classified with regard to demographic variables including age and sex and gender breakdown of

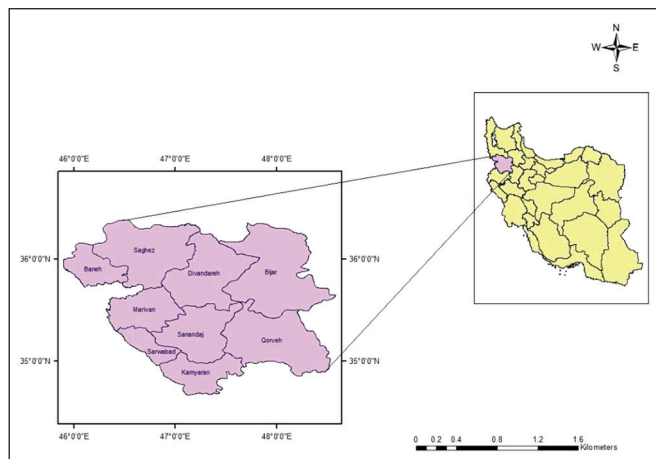


Figure 1: Location of the study area

the city or country and documented in death registration system for urban and rural provinces. In overall, 1403 patients with gastric cancer deaths were reported [Appendix]. The demographic variables were analyzed by Excel software. Also, the spatial analysis and mapping the geographical distribution of cancer related to minerals include lead, arsenic and antimony was done using GIS Applications (GIS) and Arc map, respectively. In respect of the geographical distribution of disease, the related mortality rate of the disease per 100,000 people was calculated using the following Equation:

$$\text{Rate} = \left[\frac{d}{N} \right] \times 100,000$$

Where *d* is the number of stomach cancer mortality in each city and *N* is the number of population – year for the cities.^[14]

RESULTS

As the frequency and spatial distribution maps of several important diseases with unknown etiology and treatment were drawn, the significant difference was observed between studied points. So, this difference cannot be explained by genetic differences, diet and etc. Also, social and environmental interactions could be important factors in their etiology. The variation of gastric cancer mortality rate in the Kurdistan province is shown in Figure 2.

DISCUSSION

As seen in Figure 2, the highest death rate associated with gastric cancer was reported in Divandareh, Bijar, Saghez, Qorveh and Kamiaran cities and corresponding more than 18.98/100,000 people in Kurdistan province. Although, gastric cancer rate in Marivan, Baneh and Sarwabad was lower than the average of, Kurdistan Province. A geographical area is a place that represents the symbol of complex physical, biological and cultural processes. If anyone is able

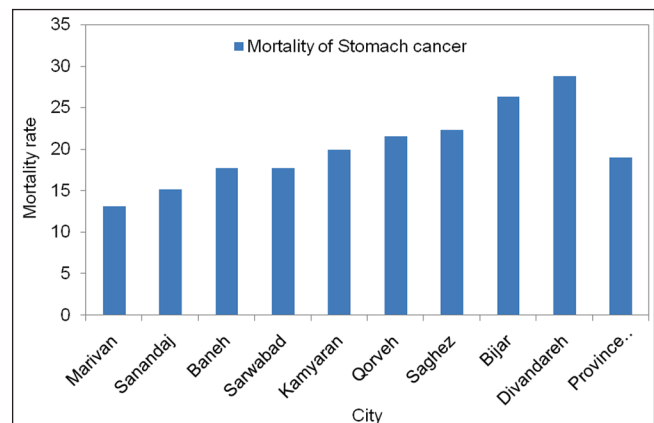


Figure 2: Frequency of deaths related to stomach cancer in the studied area (2007-11)

to analyze elements and patterns, typically they will be able to specify the conditions that are likely to.^[15] Geographic variations had studied as in health for some time with interdisciplinary topics such as pathology, geography, ecology, medicine, medical topography, geographical and epidemiological geomedicine.^[16] According to Figure 3, about 1403 patients with gastric cancer deaths were reported and among of them 918 (65.43%) and 485 (34.57%) were male and female, respectively. So, it can be concluded that due to the nature of the job and spending more time outside home, the men have more exposed to cancer-causing heavy metals and chemicals. Also, the higher cigarette consumption by men lead to greater behavioral risks. According to the ranking of Iranian center of cancer disease institute and department of medical education, the gastric cancer showed first and third ranking for men and women in Iran, respectively. Although, the world cancer report was presented 2 and 6 ranking for men and women, respectively.^[17]

Classification of mortality based on living area depicted that 617 (43.98%) and 786 cases (56.02%) was related to urban and rural areas, respectively. It may be related to lack of awareness and noncognition methods for disease preventing in rural areas and also other factors including culture, poor nutrition, poor hygiene and lack of clinical centers. In addition, environmental contaminants such as nitrogen and nitrate are one of the importance factors on incidence of gastric cancer. Nowadays, application of nitrogen fertilizers in the agricultural fields was increased for various reasons in Iran. The adjustable agricultural plants system prevents people to use more phosphorus fertilizers; thus, it will increase the level of nitrates pollution in farmland. Consumption of contaminated products with nitrate and nitrite by human and animal can lead to readily entrance to the blood circulation system and crippling of red corpuscle. Previous studies showed that the main factor of nitrate accumulation in potatoes and vegetables are fertilizers and specially nitrate fertilizers. Nitrate in vegetables, fruits and drinking water can enter to the human organism, but about 80% of them can release via daily

activities of the body. Residual nitrate in the gastrointestinal tract may be converted into nitrites by some microorganisms and enzymes. Among of nitrous compounds, about 80% are carcinogen. Are more toxic nitrites and are very dangerous for the human organism.^[18] Because gastrointestinal symptoms in patients with older age are diet, smoking and exposure to heavy metals in the unprotected transaction with the environment are considered risk factors associated with gastric cancer.^[19,20]

Figure 4 showed that the most of patients can be considered in aged people, and the average age of patients was 69 years. Most of mortality rate of patients (457 cases) associated with gastric cancer was occurred in the age class 71-80 years and fewer cases were observed in category 11-40 ages. The variation of inorganic elements concentration can influence on animals and humans life.^[21]

The spatial distribution of studied factors via GIS was used in order to providing distribution map of frequency of certain diseases and can represent the relationship between diseases and chemicals.^[22,23] Subject to spread disease and relate geographic areas with distinct roots are the issues fixed so the field of Geographical Science provided. Mcglashan demonstrated that the medical geography can be referred to discovering and discussion of about the effects of environmental factors on human health.^[24] Therefore, the heavy metals including lead, arsenic and antimony in gastric cancer patients was assessed,^[25] and the geographical distribution of these heavy metals was evaluated in the studied area. By introducing the mortality spatial distribution of gastric cancer into Kurdistan map, the relationship between studied heavy metals and gastric cancer mortality rate was estimated. Clearly identify and assess the risk factors and causes in a further step, however small, is important in order to prevent disease and promote health programs. Lam *et al.*, studied the exposure to lead and rate of kidney, lung, stomach and nervous system cancer in New Jersey workers. They reported strong relationship between concentration of lead and cancer prevalence.^[26] In addition, Türkdoğan *et al.*, (2002) demonstrated that human exposure to heavy metals



Figure 3: Frequency of stomach cancer death in respect of sexual segregation in Kurdistan province (2007-11)

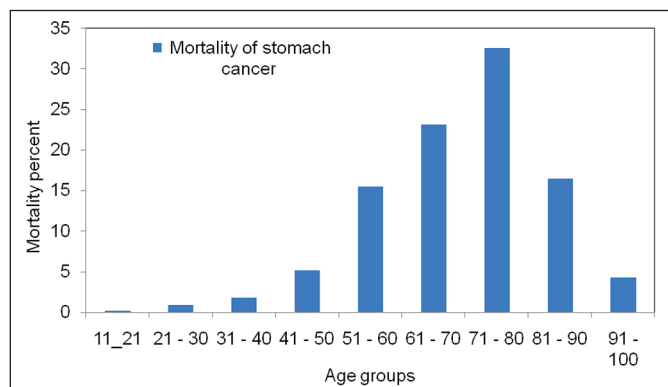


Figure 4: Death due to stomach cancer according to age category of in Kurdistan province (2007-11)

including lead, copper and antimony is a risk factor of gastric cancer. They concluded that lands in barren, mountainous and soil with high content of heavy metals can lead to the high incidence of gastrointestinal tract cancers (esophagus and stomach).^[27]

Exposure to inorganic arsenic can caused different side effects including irritation of the stomach and intestines, gangrene, women infertility and miscarriage, decreasing viruses resistance, cardiac arrest, blood pressure, brain damage, decreasing production of red and white corpuscle, DNA damage and changes in skin nature and lung irritation. High amount intake of inorganic arsenic may be increases the probability of skin, lung, testis, bladder, liver and lymph nodes cancer.^[28]

Figures 5-8 depicted that city of Bijar, Saghez and Qorveh deceased are respectively the high statistics. Also, Saghez and Qorveh Cities in the province have the highest potential of arsenic element. The amount of measured lead in Divandareh, Saghez and Bijar cities was more than other cities of Kurdistan province.

CONCLUSIONS

This significant difference in gastric cancer mortality in men and women, as in men, more than a half against disease in women. Gastric cancer mortality in rural areas is more than urban residents. Therefore, there is a significant risk factor in gastric cancer and correlates with mineral cancers because of lead, arsenic and antimony, and major amount of patients are male, it is necessary to notice the Gastrointestinal symptoms in older patients, tell a proper diet, smoking ban, lack of exposure to heavy metals and environmental nonprotective elements so it is a long step toward reducing the mortality rate of the disease.

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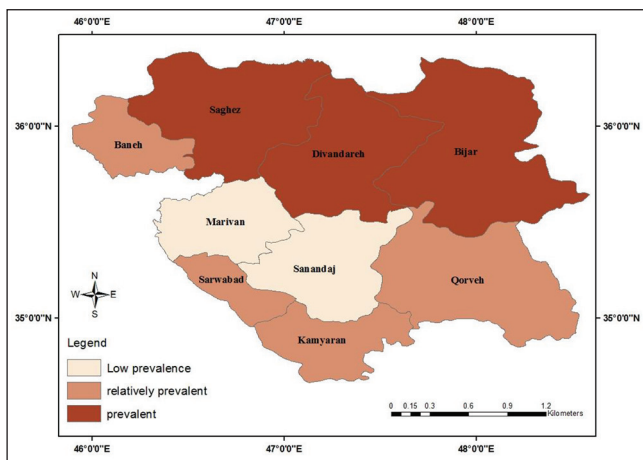


Figure 5: Geographical distribution of stomach cancer death in Kurdistan province during 2007-11

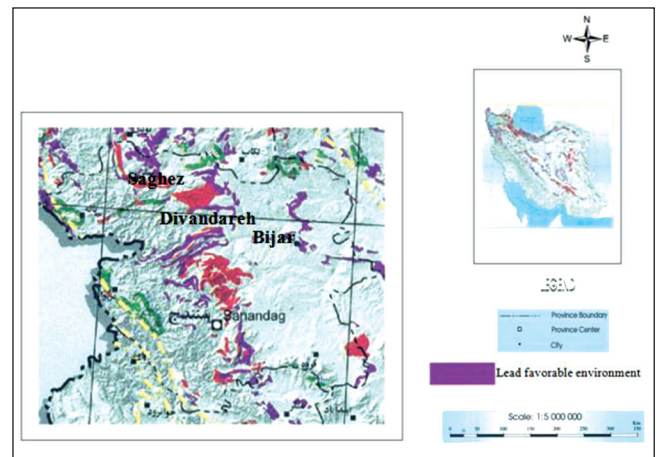


Figure 6: Geographical distribution of lead in Kurdistan province

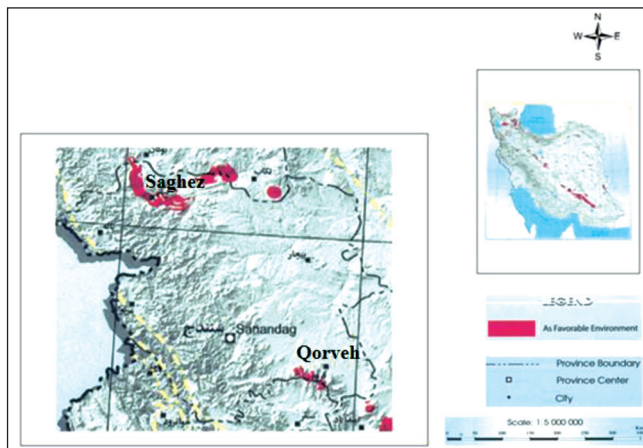


Figure 7: Geographical distribution of arsenic in Kurdistan province

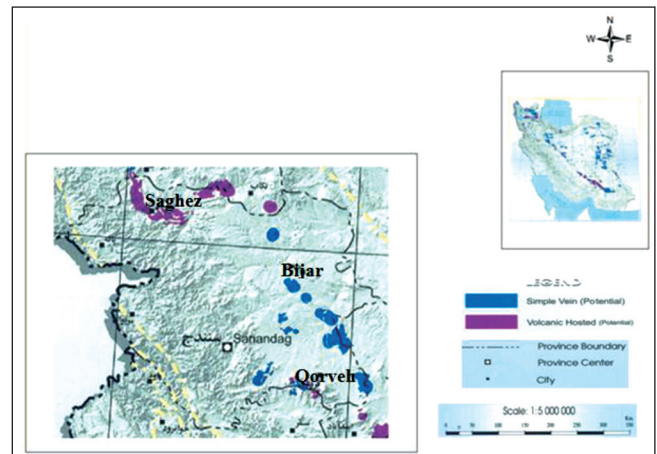


Figure 8: Geographical distribution of antimony in Kurdistan province

Appendix

The table Patients stomach cancer 2006 to 2010

Percent of total Patients stomach cancer	Total number of Patients stomach cancer	Age groups
0.4	3	0-14
0.5	4	15-24
1.0	8	25-34
2.8	23	35-44
10.4	86	45-54
22.7	188	55-64
33.0	274	65-74
25.9	215	75-84
3.5	29	Above 85
100	830	Sum total

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