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RESEARCH ARTICLE

Spatial Analysis of Skin Cancer Incidence in Iran

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Abstract

Skin cancer is one of the most common cancers worldwide, including in Iran. Variations in its incidence rate among geographical areas are due to various contributing factors. Since there has been a lack of studies on this topic in our country, the present spatial analysis of skin cancer incidence in Iran in 2009 was conducted using data from the cancer registry system for the country. The reported incidences of the disease were standardized on the basis of the World Health Organization population and the direct method. Then the data were inserted into the GIS software, and finally, using the analysis of hot spots (Getis-Ord Gi), high-risk areas were drawn. Provinces that were 1.9 SD higher or lower than the national average were considered hot spots or cold spots, with significance at the level of 0.05. In 2009, a total of 9,964 cases of skin cancer occurred, 3,696 in women and 6,268 in men (standardized incidence rates of 15.8 and 22.6, respectively). The results of the study showed that in men and women, the disease demonstrated high incidence in the central provinces and desert regions. In women, Yazd Province and in men, Qom Province had significant hot spots (p <0.05). While Isfahan, Markazi, Tehran and Kurdistan provinces were expected to be hot spots, the differences from the national average were not significant at the 0.05 level. As well, the provinces of Sistan Va Baluchistan, Kerman, and Hormozgan were identified as cold or low-risk disease regions (p <0.05). The central provinces of the country due to hot weather conditions, more solar radiation, and closer vicinity to the central desert of Iran demonstrated higher incidence rates for skin cancer, so further epidemiological studies into the etiology and early detection are essential in these areas.

Keywords: Spatial analysis - incidence - epidemiology - skin cancer - Iran

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Introduction

Cancer is known as one of the most common diseases in the world. It is the first among the three causes of death worldwide (Mathers et al., 2008; Pakzad et al., 2015a). In 2012, about 14.1 million new cases of cancer have been reported in the world of which 8.2 million have been fatal. However, it is predicted that in 2,030 the number of new cancer cases will be 21.7 million, and the number of deaths due to cancer 13 million. Those reflect the increasing burden of the disease in the future (Cancer and Organization, 2014; Pakzad et al., 2015b).

The incidence of the cancer is expected to increase in the future, as in the developed world: of every 6 people, one will be diagnosed with skin cancer in his/her lifetime (Diepgen and Mahler, 2002; Zahedi et al., 2015). Skin cancer is important because studies have shown that in 2000 it caused a loss of 756,000 years of human life due to death or disability (Lucas et al., 2006). Skin cancer is the most common type of cancer in Iran, so it is responsible for 5.2% to 32.7% of the total cancers. This form of cancer in men with Age-Standardized incidence Rate (ASR) of 19 is the first, and in women with ASR of 9.1 second most prevalent after breast cancer. However, given lower mortality, it recieves less attention than it should (Mirzaei et al., 2015; Pakzad et al., 2015b).

Previous studies have shown that the pattern of skin cancer is different in various geographic regions which can result from causal factors (Rohani-Rasaf et al., 2012; Razi et al., 2015a), such as environmental and personal. Male gender, older age, having light-colored eyes, white skin, genetics, and race are personal factors affecting the incidence of the cancer (Armstrong and Kricker, 2001; Pakzad et al., 2015b; Razi et al., 2015a). However, the impact of environmental factors is more on the incidence of this cancer. Some of such factors are occupational

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exposure, environmental pollution, outdoor activities, ozone depletion, and ultraviolet radiation (Strickland and Rosenthal, 1990; De Gruijl, 1999; Wakeford, 2004; Leiter et al., 2013).

Several studies have shown that Squamous Cell Carcinoma (SCC) is directly correlated with the increase in the sun's rays (Scotto et al., 1983). It is also shown that with approaching the equator, the incidence of melanoma and non-melanoma increases linearly: with a reduction of 10 degrees latitude, the incidence doubles (Wakeford, 2004). Jablonski also revealed that skin cancer is more associated with latitude, while it has no relation with other physical parameters of the environment, including altitude, humidity, and temperature (Jablonski and Chaplin, 2010). Mackie also showed that higher incidence of skin cancer was seen in people who work in environments outside their home due to higher exposure to sunlight and air pollution (Mackie and Quinn, 2004).

Investigating the geographical distribution of skin cancer could lead to better understanding of

the incidence pattern and the impact of environmental factors. The Geographical Information System (GIS) is one of the tools that can determine the distribution of a disease, high-risk areas, and the impact of environmental factors. There are several studies on the use of this system in similar diseases (Poulstrup and Hansen, 2004; Boscoe and Schymura, 2006; Yomralioglu et al., 2009; Jablonski and Chaplin, 2010). Awareness of the spatial features of incidence of a disease can help prioritize and provide appropriate services for health in high-risk areas. According to that, there is no study on the geographical distribution of skin cancer in Iran. This study was aimed to investigate the geographic distribution of skin cancer in Iran using GIS.

Material and Methods

The study area

Iran is a country in the Middle-East with the area of 1,648,195 square-kilometers, and the 18th largest country in the world with a population over 75 million (in 2011) . Iran has a variety of environmental conditions in terms of length and breadth of geography, topographic diversity, and a range of altitude up to 5,671 meters above sea level. The Iranian climate varies from arid to subtropical. Iran is bordered by Armenia, Turkmenistan, and Azerbaijan to the north, (as well by Russia and Kazakhstan via a water border in the Caspian Sea); Afghanistan and Pakistan in the East; the Persian Gulf and Gulf of Oman to the south; Iraq to the east; and Turkey to the northwest (Mostafavi et al., 2013). Iran is currently divided into 31 provinces.

Study design and data collection

The data were collected from Cancer Registry Center report of health deputy which is based on Iran ministry of health guideline (Goya, 2007). Data were collected retrospectively to review all new skin cancer patients in cancer registry center report of health deputy in Iran in 2009. Skin cancer was defined as icd-oc16. ASRs of cancer incidence were calculated by the direct standardization method, using the world standard population as a reference.

Table 1. Standardized Incidence Rate of Skin Cancer in Iranian Provinces Base on Sex

provinces	male	female
Ardebil	11.6	8.3
Esfahan	30.8	18.9
Ilam	23.9	15.1
East- Azarbaijan	24.9	16.9
West-Azerbaijan	19.1	13.8
Bushehr	12.2	8.9
Tehran	28.2	18.0
Chaharmahal-e Bakhtiari	19.2	11.9
South Khorasan	13.2	10.3
Khorasan-e Razavi	22.5	15.1
North Khorasan	16.9	15.3
Khuzestan	18.7	16.4
Zanjan	17.7	14.9
Semnan	34.9	26.1
Sistan And Baluchestan	4.7	3.8
Fars	27.3	19.2
Qazvin	24.7	18.7
Qom	14.2	9.1
Kurdistan	24.7	18.2
Kerman	15.7	14.6
Kermanshah	24.4	18.2
Kohgiluyeh va Boier ahmad	17.9	17.3
Golestan	12.2	7.3
Gilan	19.9	15.9
Lurestan	23.0	15.9
Mazandaran	17.0	15.2
Markazi	25.5	10.5
Hormozgan	4.8	3.5
Hamedan	28.8	15.5
Yazd	27.1	24.1
Total	22.6	15.8

After data collection, information was inserted into Excel datasheets. Using Excel, it was justified by the faster computational capabilities and the ability to convert and store data in tables which can be linked to geographical maps in ArcGIS software, also it is being an interactive environment for checking numbers simultaneously when entering data.

GIS analysis

The most recent updated electronic map of Iran and its provinces was used. To link data tables to the map, a so-called ID field was created in the Excel tables reporting the incidence of skin cancer. The code entered corresponded to the code of a province in the map data tables. The tables and map were then linked by a common field.

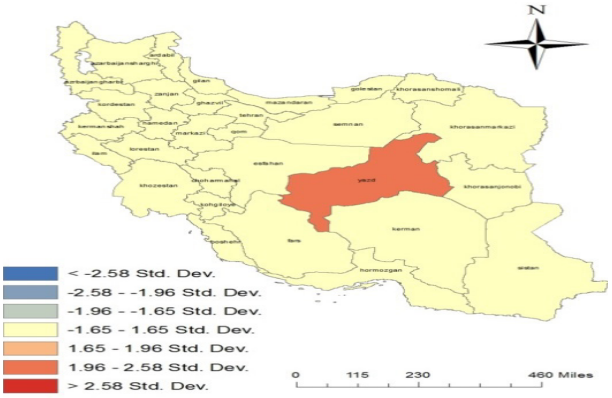

Figure 1. Hot Spots Skin Cancer in Females in 2009

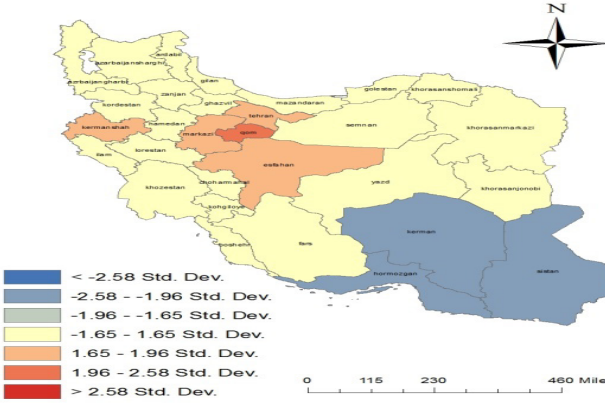

Figure 2: Hot Spots Skin Cancer in Males in 2009

Identifying disease hotspots was done using Getis-Ord Gi* (Spatial Statistics) (Figure 3). An incidence hotspot was defined as a province which not only has a high incidence of disease itself, but also has a neighboring province with a high incidence. In other words, the hotspot analysis shows that provinces with high incidence of disease become a focus of disease if there is high incidence in surrounding provinces as well. On the contrary, it can be said that 'cold spots' are provinces with not only low incidence, but also with low-incidence neighbors. Provinces that are higher or lower than the national average were 1.96 SD considered Hot spots or cold spots as were significant at the level of 0.05%.

Results

In 2009, a total of 9,964 cases of skin cancer occurred. About 3,696 women and 6,268 men suffered from the disease.The annual incidence of skin cancer was 22.6 per 100,000 in men and 15.8 per 100,000 in women. Our results showed that the highest incidence of skin cancer (26.1 Per 100,000) in women in Semnan Province, and after that the highest incidence was observed in Yazd and Fars Provinces with 24.1 and 19.2 per 100,000, respectively. The highest incidence of skin cancer in men was seen in the provinces of Semnan, Shiraz, Hamedan, and Tehran with 34.1, 30.8, 28.8, and 28.2 per 100,000, respectively.

The distribution of areas with a high incidence of disease was in the central provinces and desert regions. Figures 1 and 2 show the analysis of hot spots of skin cancer in women and men. In Figure 1 which is related to the incidence of skin cancer in women, it is shown that

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}}$$

Figure 3. Getis-Ord Gi* (Spatial Statistics) - where Xi is the Attribute Value for Feature j, wij is the Spatial Weight between Feature i and j, n is Equal to the Total Number of Features

Yazd had significant hot spots ($p < 0.05$).

In Figure 2 which is related to the incidence of skin cancer in men, it is shown thatthe central provinces of the country have high incidence, so Qom province is considered as a hot spots ($p < 0.05$). However, the provinces of Isfahan, Markazi, Tehran, and Kurdistan were hot spots, but the differences were not significant at the 0.05 level than the national average. In addition, the provinces of Sistan Va Baluchistan, Kerman, and Hormozgan were identified as cold or low-risk disease regions ($p < 0.05$). Table 1 shows Standardized incidence rate of skin cancer in Iranian province.

Discussion

There is a very high incidence of skin cancer compared to other cancers. Skin cancer is known as the most common cancer in Iran, but the mortality from the cancer is low. The incidence of the cancer is high in the central regions of Iran although there is lower incidence of skin cancer in the country than the Western countries.

Considering changing the type of covering clothing and improving registration systems in Iran, the incidence of the cancer is rising. Hence, the incidence and distribution of the cancer is important (Marks, 1995).

Distribution of skin cancer varies in different countries in the world. Developed countries and with the white race, including Australia, New Zealand, and the United States have the highest incidence (Jemal et al., 2011). The high incidence of skin cancer in developed countries could be due to exposure to the sun's rays, work in an open environment, air pollution, depletion of the ozone layer, covering the body style, race, and the increase in lifetime (Gloster and Brodland, 1996; Diepgen and Mahler, 2002). The non-uniform distribution was seen for skin cancer is in Iran, so that in the desert and wilderness areas, as well as densely populated provinces, the incidence was higher (Afzali et al., 2013).

The incidence of skin cancer is associated with hazardous solar radiation, as Ultraviolet (UV) radiation has been known as the main cause of melanoma. Wakeford (2004) showed that with a reduction of 10 degrees latitude, the incidence of skin cancer doubls. Jablonski and Chaplin (2010) also revealed that skin pigmentation

is directly correlated with the high doses of UV rays. Several studies have been conducted in our country about the relationship between solar radiation and skin cancer, but they did not see a clear and significant relationship (Nabizadeh et al., 2010; Kazemi et al., 2015). This may be due to incomplete registration of cancer by the province, lack of the breakdown of skin cancer by parts of the body exposed to direct radiation of the sun, and not considering all skin cancers.

In our study, provinces of Yazd, Isfahan, Qom, Tehran, and Markazi are hotspots. Other studies also have confirmed the high incidence of skin cancer in these provinces (Razi et al., 2015a). It is predictable because the regions are desert. Other studies have also shown that the incidence of melanoma and non-melanoma near the equator rises linearly (Wakeford, 2004; Razi et al., 2015b).

In our study, the provinces of Sistan Va Baluchistan, Kerman, and Hormozgan were identified as cold or low-risk disease regions. The above areas are hot, but the incidence of skin cancer is expected to increase due to sun's rays. The defect reporting, due to confounding factors such as race structure and the type of covering clothingare responsible (Nabizadeh et al., 2010).

Our study also showed that the incidence of skin cancer was greater in men than women, and the number of high risk provinces was higher in men than women. The findings were consistent with other studies (Afzali et al., 2013; Kazemi et al., 2015; Mirzaei et al., 2015; Razi et al., 2015a). It seems that men's lifestyle can affect the incidence of skin cancer. Features of the work of men and more exposure to the sun's rays,and lack of sun protective behaviors, such as not using sunscreen products, can justify a greater incidence of skin cancer in men.

In this study, we tried to identify any variation in the distribution of disease and hot spots using Getis-Ord Gi* (Spatial Statistics). Although high-risk areas in the study reflect the importance of the regions with a high incidence of skin cancer, several factors may be involved, and should be noted. The high incidence of risk factors in hot spots, incomplete registration data, and the lack of a full report and the data classification are the factors should be considered in spatial analysis of national data.

Skin cancer is now the most common cancer in Iran. Given the high incidence of skin cancer in the central provinces of the country, giving priority to the province to provide preventive and curative services can be effective in reducing the incidence of the cancer.

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