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Geographic Distribution of Cancer Cases in Isfahan Province/2006–2010

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ABSTRACT

Background: To facilitate analysis, interpreting and sharing cancer data and investigation spatial and geographical aspect of cancers in Isfahan province, cancer cases distribution was displayed using geographic information systems (GIS).

Methods: About 118,000 cancer data, which were confirmed in national cancer registration unit were extracted. Age-specific incidence rate and age standardized rate (ASR) of cancer cases from 2006 to 2010 was calculated for Isfahan province and its different districts. Distribution of ASR was determined according to sex and age groups. Spatial maps were drawn with the help of Arc GIS version 10 (ESRI, Redland, CA, USA) software in choropleth based maps. The data are classified in GIS environment by means of quantile method. Data were described with the help of maps spatially.

Results: Age standardized rate of cancers was higher in men than in women (134.58 vs. 115.4). The highest ASR was reported in the Isfahan (ASR: 133) and lowest in the Chadegan counties (ASR: 28). Different geographical distribution patterns of cancers were seen in district level. Cancer incidence was higher in the Isfahan, Lenjan, Fereidon Shahr and Falavarjan districts (134.3, 117.2, 113.5 and 111.1 respectively) among men and in Isfahan, Shahin Shahr, Lenjan and Najafabad districts (122.8, 102.3, 94 and 93 respectively) among women. The incidence rates of most cancers were lowest in the North East region of the province compared to the rest of the region

Conclusions: Using GIS for visual displaying of cancers facilitated communication with the policymakers and community. This study provided hypotheses about differences in the incidence of cancer in Isfahan districts. Higher age-specific incidence rate in the Isfahan city is probably a reflection of problems in addressing the patients in cancer registration. Complementary studies are needed to evaluate lower ASR in the North East regions of the province.

Keywords: Cancer, geographic distribution, geographic information systems, Isfahan

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INTRODUCTION

In Iran, cancer is the third leading cause of death.[1] Changes in lifestyle and disease patterns, along with increasing life expectancy, introduced cancer management as an inevitable priority. Systematic registration of cancer data in Iran dates to at least

two decades ago.[2] Coverage of data registration in 2009 exceeded 93% in national official reports.[3] This comprehensive coverage of the recording, provides good opportunities for researchers to design and implement surveys and studies on epidemiology, screening, management and control of cancers.

One of the first steps in cancer control is identifying where the cancer burden is greater than expected values. It has long been recognized that the incidence of cancers varies by regions,[4,5] possible reasons can be location-based environment exposure and shared cultural and behavioral risk factors.[4]

With the growth of communication technology nowadays scientists are not the only audience and users of cancer data. Policymakers, media, NGOs and even the ordinary people are other groups who are seeking to access and analyze this data. Reporting spatial aspects of health data to policy makers and public whether in the form of descriptive report or results of a research project or on a website is challenging. Therefore, employing efficient methods to display and provide this information is especially important to facilitate information transfer and communication with stakeholders.[6]

Geographic information system (GIS) software as a holistic approach allows cancer data to be stored, analyzed, and displayed spatially and facilitates interpretation and sharing of cancer findings.[7] Cancer risk assessment, evaluation of possible spatial and geographical associations and detection of cancer clusters are from other applications of GIS in the cancer field.[7,8] For this widespread capabilities, nowadays GIS is introduced as an essential component of cancer registries and variety of reporting and map designing standards were developed.[9] Recently, cancer incidence maps are illustrated in Iranian annual national cancer registration report.[3]

Numerous examples confirm the utilization of GIS in cancer control programs.[10-13] For example the first time that concern rose about high prevalence of brain cancer in residents of Missouri State of USA, which fueled by extensive media coverage, a series of prevalence and incidence maps and evidence based spatial analysis relieved the concerns.[14]

In Trabzon province, Turkey, the relationships between the distribution of cancer cases and geo-environmental factors were examined using GIS. The results provided data about the cancer occurrence density and distribution of cancer types. A relationship between breast, skin and thyroid cancer cases with land cover and elevation class was determined.[15] Mosavi-Jarrahi in a study of the inner city of Tehran, Iran, identified clusters of childhood cancer using GIS.[16]

Iranian national cancer reports provide valuable data about cancer incidence rates down to the provincial level. However, in Isfahan province, cancer control planners need to access to the locally information products on common cancer cases, which can lead to etiologic studies and subsequent interventions. Because cancer maps historically have raised public concerns, it is essential that these maps be designed in an accurate, clear, and interpretable manner for the broad range of users who may view them. Our findings can be used to facilitate communication with key stakeholders. Comparison of cancer occurrence in various populations may provide clues to probable etiologic hypothesis and propose complementary spatial based studies about cancers. The objective of this study was to illustrating the incidence and distribution of common cancers in Isfahan province in county level which can be introduced strategies for policy makers to plan cancer control programs for reducing the cancer burden in province.

METHODS

Study design and data collection

In Isfahan province, cancer registration was established officially in 1995. Cancer data are gathered from multiple sources including hospital records, records from pathologic facilities and death certificates. The information includes primary location of the tumor, date of cancer diagnosis, morphology and histology and its behavior. Demographic information of the patients includes identity profile and residence. Cancers are coded according to the International Classification of Diseases for Oncology, 3rd edition (ICD-O-3). After primary phase of editing, the data are transmitted to national Center for Disease Control and Prevention at least annually. In this center, the data from all local registers are integrated and other phases of revision and edition and the complementary process for deleting the repeated cases take place. The cancer cases are classified according to the province of residence at the time of diagnosis, and the data send back to the local registers. National cancer registration has been introduced in details other where.[17]

All cancer data which meeting eligible criteria for national registration and place of residence at the time of diagnosis were recorded "Isfahan province" for 2006 through 2010 diagnosis years, were selected. The determination of exact district of residence according to the address of patients and other phases of deletion of the repeated cases took place separately in each district and finally in all over the province by experienced manual reviewers.

Statistical and data analysis

The data bank was produced using SPSS Version 20.0. Armonk, NY: IBM Corp. (Chicago, IL, USA) software and MS EXCEL (Microsoft, Redmond, WA, USA) software with Persian fonts.

The incidences are expressed as the number of new primary cancers per 100,000 persons at risk per year. Incidences were age and sex adjusted according to the standard World population based on 5-year age groups.[18] Population estimates in counties were obtained from the health deputy of the Isfahan University of Medical Sciences. For cancer sites that pertain to one sex only, the population at risk was the sex-specific population (e.g., females for breast and male for prostate cancer). Incidences were presented for each district in two sexes and with common cancers.

The age standardized rate (ASR) of cancers had been mapped by using Arc GIS software version 10; (ESRI, Redland, CA, USA). Cartographic principles were used for map designing. Classed choropleth maps, which are based on statistical data aggregated over previously defined regions (e.g., districts) were the groundwork of maps formation. Political boundaries of the districts were the unit of analysis. The quantile method for ranking data, which ranks the enumeration units by the variable and then places an equal number into each class, was used. Sequential color scheme was used to represent classes of data.

RESULTS

Over a 5-year period (2006–2010), 18,323 new cancer cases were registered in Isfahan Province, 9919 men (54.1%) and 8404 women (45.9). During these years, we witnessed an increase in the annual incidence of cancer in the province [Figure 1].

The mean (± standard deviation) patient age was 52.9 (17.12) in women and 59.82 (17.57) in men. The age-specific incidence rate is presented in Figure 2. The data shows that cancer incidence gradually increased with age, but there was some decline after 80.
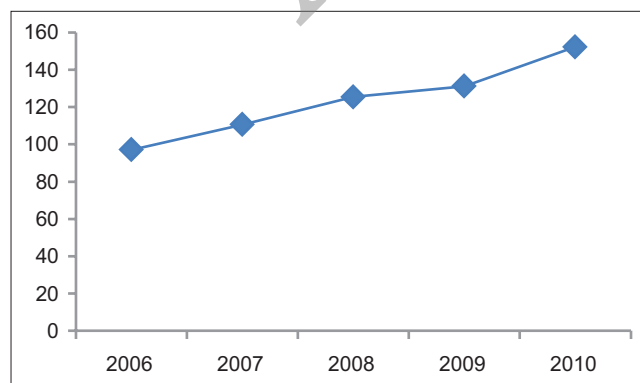
The ASR for all cancers in males was 134.5 and that for females' was 115.4. Figure 3 shows the ASR of cancers in men and women according to the site.

Isfahan province consists of 23 districts, 21 districts (all except Kashan and Aran and Bidgol) is covered by Isfahan University of medical science. The ASRs of common cancers were calculated in these districts. Figure 4 summarizes these results, showing the ranking of cancers for men and women. The top 5 cancers in males according to ASRs were skin (24.3), bladder (12.1), prostate (11.7), colorectal (9.5) and stomach (9.2); in females were breast (27.3), skin (14.7), colorectal (7.4), thyroid (5.5), and hematopoietic system (5.2).

Using GIS, the maps were depicted, which were illustrated in Figures 5-7. Different geographical distribution patterns of cancers were seen in district level. The incidence of cancers in east regions of the Isfahan province seems lower than in the west. Among males, the highest incidence rate of cancer cases was seen in Isfahan district (134.3) followed by Lenjan, Fereidon Shahr and Falavarjan districts (117.2, 113.5 and 111.1 respectively). In females, cancer incidence was higher in the Isfahan, Shahin Shahr and Meime, and Lenjan (122.8, 102.3, 94 and 93 respectively).

DISCUSSION

Information on cancer patterns is an important basis for determining the priorities for cancer prevention and control in different regions. According to Figure 1, the incidence rate of all cancer combined increased from 2006 to 2010 in overall. Mokarian *et al.* reported such a trend in Isfahan province.[19] Lifestyle changes and increases in the risk factors of cancer, improving cancer detection methods and more complete cancer registration may play a role. Incidence rate increases exponentially by age for most cancers. However, as shown in Figure 2, it is usual to see some decline in the oldest age groups. This is partly due to co morbidities which lead to less efficient
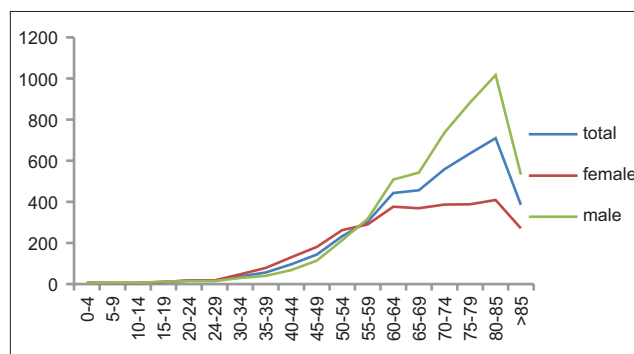

Figure 1: Age-specific incidence rate of cancer cases by year in Isfahan province/2006–2010

Figure 2: Age-specific incidence rate of cancer cases by sex in Isfahan province/2006–2010

case ascertainment; another cause may be decrease in the proportion of the population with predisposition to cancer, and hence that those who reach old age have lower risk.[20]

According to data, cancers of the bladder, colorectal, prostate and skin among men and cancers of the breast, skin and thyroid among women were more common in Isfahan province compare to other parts of the country and some part in the world.[21,22]

With regard to the top 10 cancers, there is some little difference between the results of our study and national cancer registration reports.[3,21] National database uses a

large amount of data, derived from cancer registries from different provinces which limit proper data clearing and management.

Detailed analysis of data in district level showed different geographical distribution patterns of cancers in the province. The highest incidences of cancers in both sexes were seen in Isfahan County. Isfahan city is the center of the province. It is faced with the problems of industrialization and transitional lifestyle that puts it at increased risk for cancer. More than two million people live in Isfahan city; some of them are immigrant from other districts or provinces. Moreover, sometimes patients who
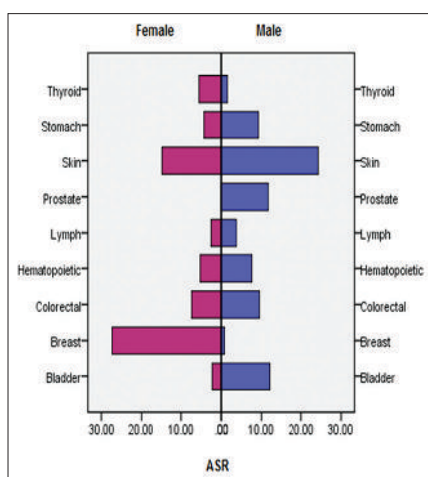

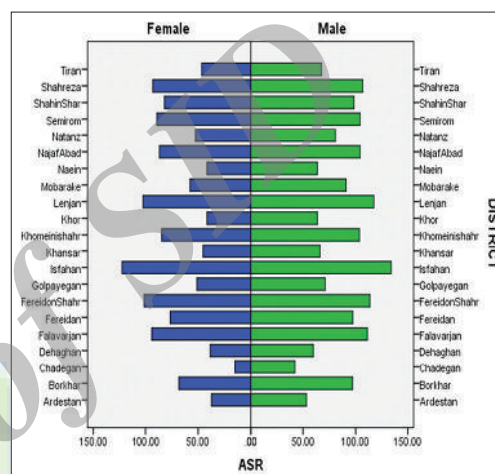**Figure 3: Age standardized rate of cancer cases by site and sex in Isfahan province/2006–2010**

Figure 4: Age standardized rate of cancer cases by districts and sex in Isfahan province/2006–2010
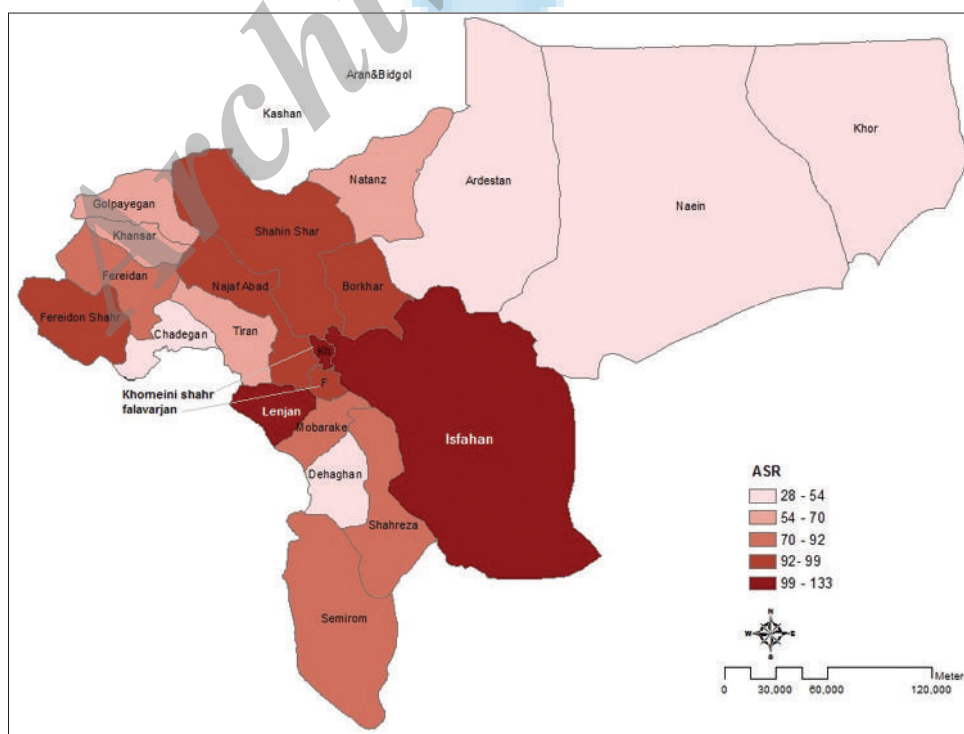

Figure 5: Age standardized rate of cancer cases in both sexes/Isfahan province/2006–2010
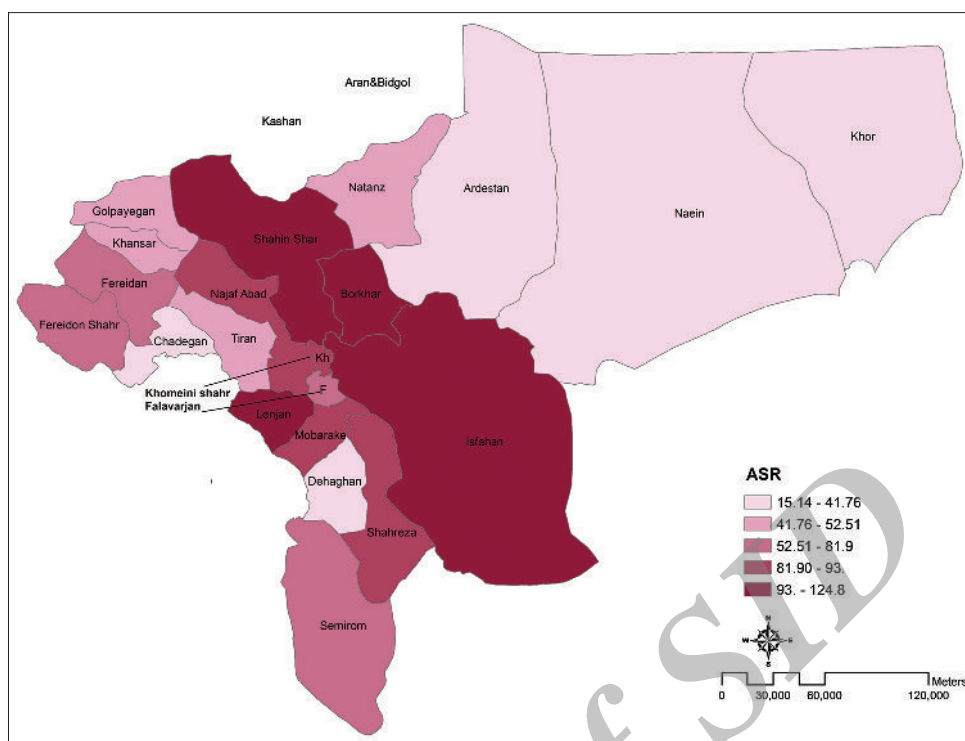
Figure 6: Age standardized rate of cancer cases in women/Isfahan province/2006–2010
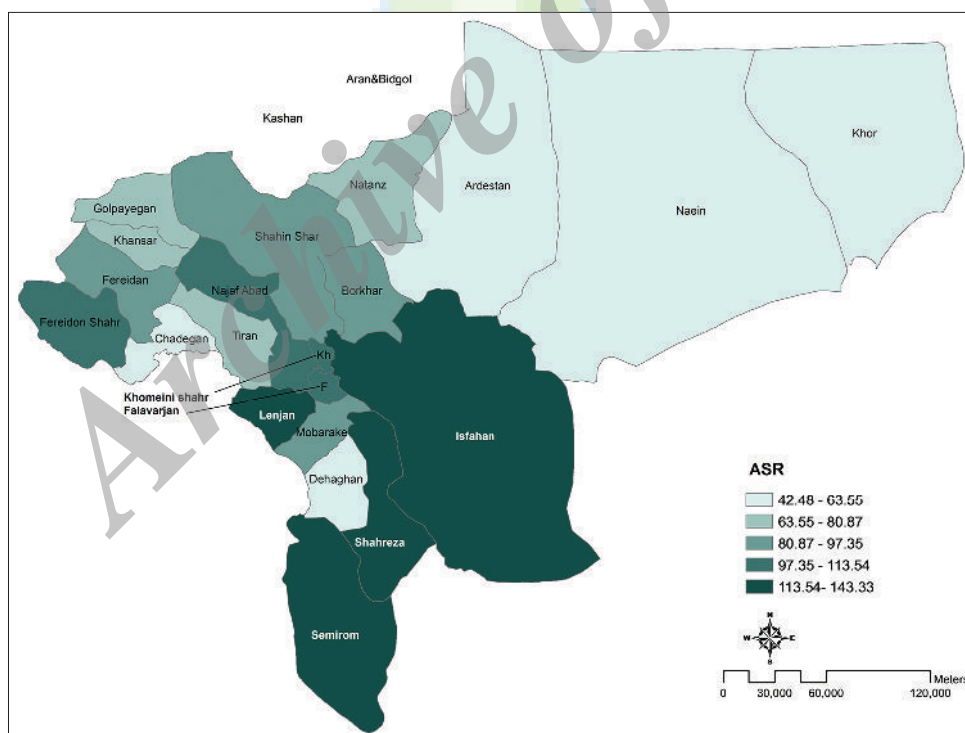

Figure 7: Age standardized rate of cancer cases in men/Isfahan province/2006–2010

are seeking for medical services in the Isfahan city, give an address from their relatives who are residence in the city, this can lead falsely increase in cancer incidence. In Fars, another province in Iran, analysis of the spatial distribution of cancer shows significant differences between different areas. As our study, the highest ASR was observed in Shiraz, which is the capital of county in Fars.[23]

At a glance more heavily populated districts had more cancer cases; this does not apply in Fereidonshahr

County. Complementary studies are recommended to study the subject

Incidence rates are predominantly low in North East portion of the province (Nain, Khor and Ardestan counties). Though, climatic hypotheses can be proposed to justify this pattern, these assumptions should be made with caution and in the first step, underreporting must be rule out. Patients in the boundary districts may seek services from neighborhood provinces. However, it seems still the best explanation of the low incidence rate of cancer in these districts might lies in executive problems in cancer registry.

CONCLUSIONS

Using GIS for visual displaying of cancers facilitated communication with the policymakers and community. This study provided hypotheses about differences in the incidence of cancer in Isfahan districts. Higher age-specific incidence rate in the Isfahan city is probably a reflection of problems in addressing the patients in cancer registration. Complementary studies are needed to evaluate lower ASR in the North East regions of the province.

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