GIS Based Cancer Density Maps: A Case Study in Eastern Black Sea Region of Turkey

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Abstract

Through the developments of Geographic Information Systems (GIS) technologies and statistical methods in spatial epidemiology, health and population data have started to be examined together. It enabled the research on logical spatial variation of disease risk. In this study, the distribution of cancer cases which were registered during the years 2000-2007 in the Eastern Black Sea Region of Turkey was presented on cancer maps by GIS. Using ArcGIS, cancer incidence values in the seven provinces of this region were calculated by taking population into account for each county-based region. According to the cancer incidence values for each county, the classification of cancer rates were viewed on the thematic map by GIS. Thus cancer density maps were produced for each allocation unit as to calculate incidence values. Spatial distribution of different cancer types were showed on thematic maps.

Key words: Health, GIS, Spatial Epidemiology, Disease Map, Turkey.

1. INTRODUCTION

Cancer takes place as an important health issue nowadays. Cancer has been a notifiable disease in Turkey since 1982. The Cancer Control Department of the Ministry of Health has been collecting notifications about cancer cases in whole country since 1989. However, notifications represent only a part of real cases and forms are not standardized in line with international standards. Therefore, to calculate real figures of incidences in Turkey, the Cancer Registry and Incidence Project was established to establish the eleven cancer registries which are population-based cancer registry are a representing the whole country (MECC, 2008).

The first cancer maps produced in 1875 (Haviland, 1875). The modern-day disease atlas began with Howe's National Atlas of Disease Mortality in the United Kingdom (Howe, 1963). The first cancer atlases in the U.S. mapped 34 types of cancer at the small area level (Mason et al, 1975). The second generation of cancer atlases included results of model-based procedures, such as time trends map based on a straightforward Poisson model (Pickle et al., 1987). In Turkey, the first cancer maps produced in 2005 as a thematic cancer density map for Trabzon province by GIS (Colak, 2005). Several health GIS studies are conducted in Turkey over the past 5 years.

Disease registries have been sources of data for many GIS case studies but registries have not been fully linked to Geographical Information Systems (GIS) in Turkey. Cancer registries include residential address information, but that information is protected by laws governing privacy and confidentiality. Thus, the research studies is typically faced with using health data that are aggregated to predefined with administrative unit code to geographical units, such as provinces, counties, villages, or districts.

Forming cancer control programme and putting strategic action plans into practice became important because it ranked as a second death reason in Turkey and the density of its case increased. Examining variations of cancer cases in time and spatial is necessary to develop control strategies struggling cancer and to put cancer control programme into practice. Descriptive statistics on cancer occurrence are traditionally used to formulate hypotheses that might explain the observed differences (geographically, over time, in population subgroups) and that can be tested by further study. Such statistics are also essential components in the planning and evaluation of cancer control programmes. After providing cancer statistics with reliable data, cancer maps have to be created, and then, the geographical change of cancer cases have to be analyzed on these maps.

2. MATERIALS AND METHODS:

The main concern of this paper, database will be built with the using of GIS techniques for examining the distribution of cancer cases in the Eastern Black-Sea Region of Turkey and thematic maps relating to cancer cases in allocation units will be created.

Study area:

Turkey is a transcontinental Eurasian country. As of 2007, the population of Turkey stood at 70.5 million with a growth rate of 1.04% per annum. Turkey is geographically divided into seven regions. The territory of Turkey is subdivided into 81 provinces for administrative purposes. Each province is divided into districts, for a total of 923 districts (Wikipedi). The study area includes the 7 cities within the Eastern Black-Sea Region of Turkey. These are, Ordu, Giresun, Trabzon, Rize, Artvin, Gümüşhane and Bayburt (Figure 1).

Data collection:

In this study, cancer statistics are provided from the Cancer Registry Centers of Health Directorate of the Eastern Black-Sea Region of Turkey. The cancer cases data recorded during the years 2000-2007 was used. The cancer registries include the patient's age, sex and address, cancer type with International Classification of Disease (ICD-10) code, cancer topology, and diagnosis date. The case study made use of 15.823 data records for new cancer patients. Some records of cancer cases lacking adequate address information were excluded. After this elimination, a total of 15.299 reported cancer cases which are registered by the Cancer Struggle Departments of Trabzon province (8545 cases), Rize province (2059 cases), Gumushane province (937 cases), Giresun province (2408 cases),

Bayburt province (223 cases), Artvin province (1008 cases), and Ordu province (119 cases) were used in the production of cancer maps.

Figure 1. Study Area

Administrative unit map of the Eastern Black-Sea Region of Turkey was used as the base map for the application to cancer cases is demonstrated on it. In this base map, there are graphical information representing the boundaries of counties and villages, and the centers of administrative units. The spatial data of administrative units also include their populations and administration unit codes. The base map was transferred into topological data structure using ArcGIS 9.2 software and the data was stored in the geodatabe (.gdb) files. This dataset comprises of two data layers, one is administrative boundaries in polygons and the other is administrative centers in points. Population data for the years 2000 and 2007 are obtained from Turkish Statistical Institute.

Producing cancer maps: (Mapping cancer cases?)

In order to use cancer data sets in GIS, the data sets must first be captured and linked to a foundation spatial database. Capturing area data in a GIS involves "joining" (Cromley and McLafferty, 2002). Joining requires that each administrative unit have a unique identifier such as administration unit code.

Cancer cases according to their address information were matched to an administration unit code. Thus, cancer data sets were linked to base map in foundation geodatabase via GIS. For each cancer case, an administration unit code were recorded to cancer registry dataset for geocoding. This dataset were collected in dbase format and related to geodatabase.

The distribution of cancer cases which were registered during the years 2000-2007 in the Eastern Black Sea Region of Turkey was presented on cancer maps by GIS. Firstly, the number of cases were determined from cancer dataset for each county and added on administrative unit feature dataset. In this respect, the county-based distribution of ratios of cancer cases to population in the Eastern Black Sea Region of Turkey between the

years of 2000-2007 were monitored on a thematic map (Figure 2). The graduated point symbol was implied cancer cases for each county. It is normalized to divides the values of the number of cancer cases by population for each county to create a ratio.
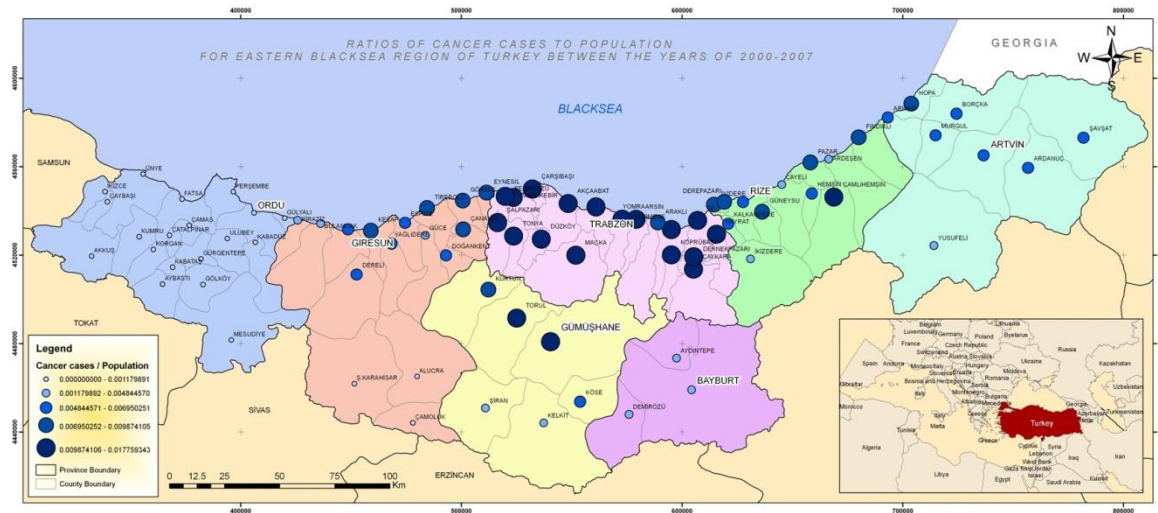

Figure 2. Ratios of cancer cases to population for Eastern Black Sea Region of Turkey

In order to be able to perform some statistical analysis and comparisons, calculation of cancer incidence values for each administrative unit are needed. A cancer incidence rate is the number of new cancers of a specific type occurring in a specified population during a year, usually expressed as the number of cancers per 100,000 population at risk (NCI, 2008).

$$\text{Incidence rate} = (\text{New cancers} / \text{Population}) \times k \qquad (k = 100\,000)$$

For this purpose, the number of cases are calculated from cancer dataset for each administrative unit. Population data were computed by the average out of census data for the years 2000 and 2007. Using ArcGIS, cancer incidence values in the seven provinces of this region were calculated by taking population into account for each county-based region. According to the cancer incidence values for each county, the natural breaks classification of cancer rates were viewed on the thematic map by GIS. Thus cancer density maps were produced for each county as to calculate incidence values (Figure 3).

Another thematic cancer map which produced by GIS and spatial distribution of different cancer types for Trabzon province were showed on pie chart (Figure 4). It is symbolized common cancer types with a chart for each county on this map. A pie chart on this map shows the distribution of lung, bladder, stomach, breast and thyroid cancer types. The chart size is represented by ratio of the number of cancer cases to population for each county.
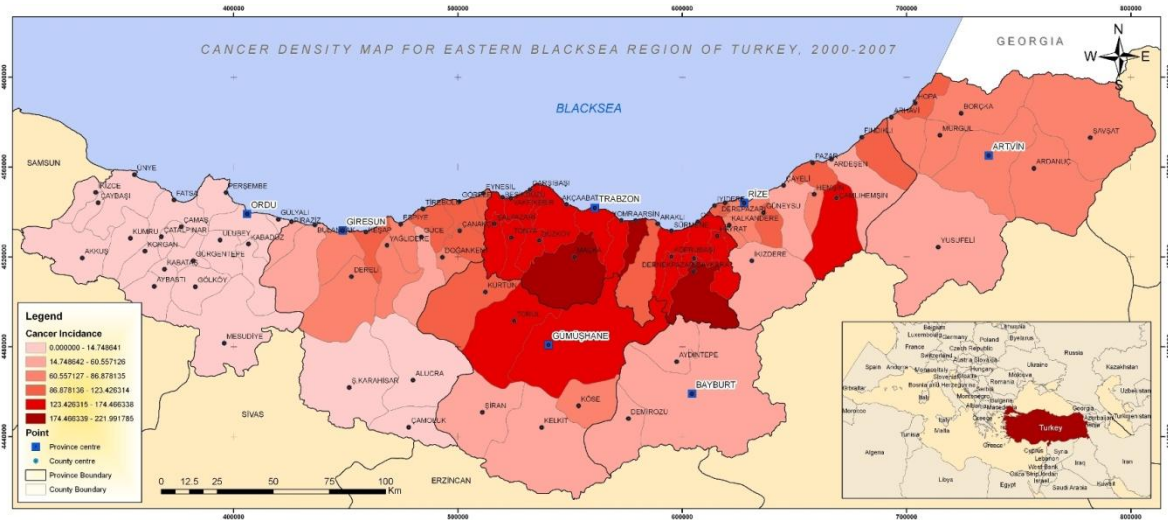
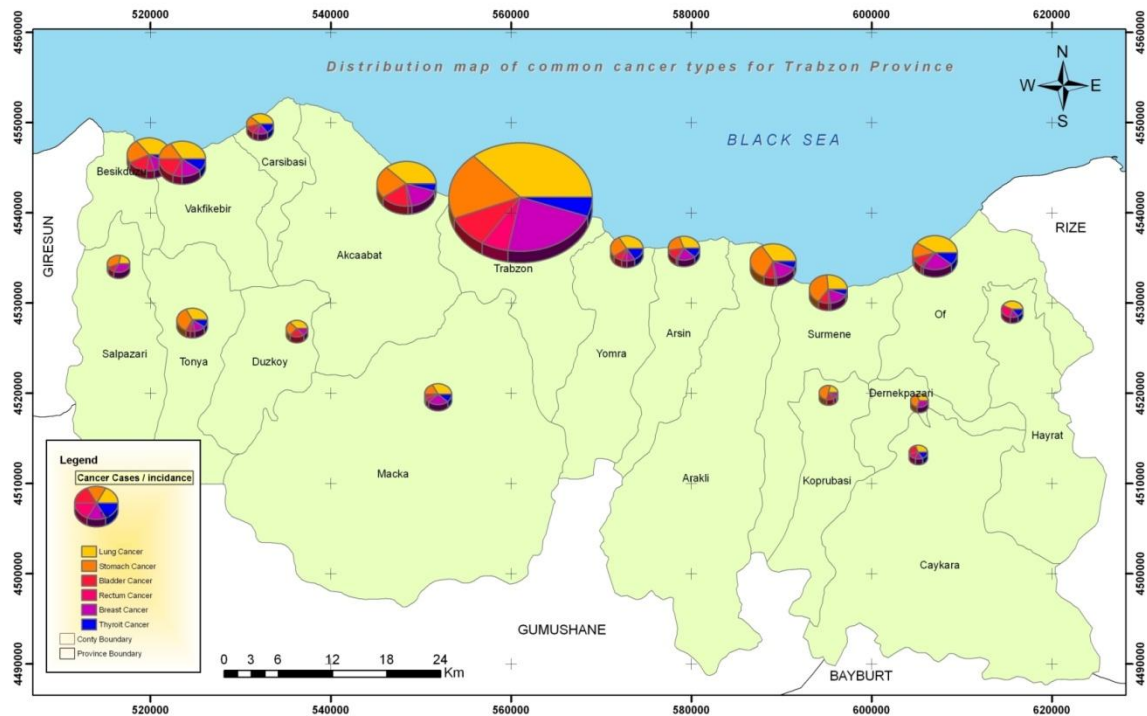Figure 3. Cancer density map for Eastern Black Sea Region of Turkey

Figure 4. Distribution map of common cancer types for Trabzon province

3. CONCLUSION

Cancer takes place as an important health issue nowadays. Forming cancer control programme and putting strategic action plans into practice became important because it ranked as a second death reason and the density of its case increased. Examining variations of cancer cases in time and spatial is necessary to develop control strategies struggling cancer and to put cancer control programme into practice. Correlation relations

such as variations in different societies, environmental factors, and social habits and life style of humans in these societies are examined. For examining these differences, the number of existing cancer cases has to be determined firstly. After providing cancer statistics with reliable data, cancer maps have to be created, and then, the geographical change of cancer cases have to be analyzed on these maps. Creating cancer maps is necessary for obtaining information about its cases in which region with which frequency, examining the distribution of cancer types geographically, and determining that which region has the highest density of its case.

4. REFERENCES

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