USING GIS TECHNOLOGY TO ANALYSE TUBERCULOSIS INCIDENCE IN IZMIR

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Abstract

Tuberculosis is one of the most contagious diseases. Although it has been present for over 5000 years, it is still one of the most significant public health problems. Tuberculosis is defined as a disease caused by a bacterium called *Mycobacterium tuberculosis*. Its incidence has increased and decreased over time, but it has always been a constant threat to public health. In the 1940's some medicines were discovered to treat tuberculosis, so it slowly began to decrease. But then countries let their guard down, tuberculosis was neglected and so cases increased.

The aim of this study was to create a disease density map. Why tuberculosis? The reason being that tuberculosis has attained an important place among contagious diseases. This study will determine the distribution of tuberculosis in the Izmir Province of Turkey. When we take a glance at the mortality rates due to tuberculosis, we recognize that this disease is common in crowded cites. Izmir is the third most crowded city in Turkey. In this study, we investigated tuberculosis which had been reported to the Contagious Diseases Department of the Izmir Province Health Directorship with the form 014. This study will show a GIS based approach to an analysis of tuberculosis data. Case data were obtained from Izmir for the period of 1994-2006. GIS was used to show the distribution of tuberculosis cases. The mapping of the disease density is significant because it may be a clue as to its causes and affects and can also provide an insight into the possible changes and rates of the disease in the coming years. Also this study is an example for medical geography.

Key words: *Tuberculosis, GIS, Izmir, Health, Medical geography*

1. Introduction

Medical geography, a subdiscipline of geography, is an interdisciplinary and holistic study of health, illness, and disease by specialists from a wide variety of social, physical, and biological sciences. Working in different cultural systems and diverse biospheres, medical geographers examine the distribution of health-related phenomena over time and the ways in which these phenomena interact and determine the status of human health in a community. It aims to improve the understanding of the various factors which affect the health of populations and hence individuals. It is also called health geography.

Tuberculosis, or TB, is an infectious bacterial disease caused by *Mycobacterium tuberculosis*, which most commonly affects the lungs. It is transmitted from person to person via droplets from the throat and lungs of people with the active respiratory disease (CDC, 1998). Tuberculosis (TB) is a major cause of illness and death worldwide, especially in Asia and Africa. Globally, 9.2 million new cases and 1.7 million deaths from TB occurred in 2006 (WHO, 2007).

Globally, the slow decline in incidence per capita is more than offset by population growth. This means that the number of new cases was still increasing between 2005 and 2006, from 9.1 to 9.2 million (an increase of 0.6%). The increases in numbers of new cases were in the African, Eastern Mediterranean, European and South-East Asia regions.

Worldwide the outlook has been far less encouraging. World Health Organization declared TB a global health emergency. Approximately one third of the world's population is

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infected, and an estimated 1.7 million die each year. The vast majority of new cases occur in sub-Saharan Africa. Spread of TB is especially rapid in areas with poor public health services and crowded living conditions. In homeless shelters and prisons, crowded conditions and inadequate treatment often go together. Areas where living conditions are disrupted by wars, famine, and natural disasters also are heavily affected. Demographic factors, such as population growth and changes in the age structure of populations, will account for 79.5% of the predicted increases in new cases. Age-specific incidence rates in sub-Saharan. The World Health Organization (WHO) estimates that between one and a half and two million people die every year of tuberculosis. The estimates are that there is a TB death every minute (WHO, 2008).

Why do some geographical areas have low rates of tuberculosis (TB), while others have high rates? Which factors are associated with high rates? Geographical Information Systems (GIS) is used to investigate the individual and ecologic factors associated with higher rates of TB. TB data were recorded from 1994-2006 for the districts of Izmir. A range of economic, social, and demographic features were described for each district. The aim of the study was to determine the distribution of tuberculosis in Izmir, Turkey. So, GIS and the National Population Census (2000) were used. This study will show a GIS based approach to an analysis of tuberculosis data. GIS technology has dramatically enhanced the precision with which variations in local conditions and TB distribution can be explored. Tuberculosis has attained an important place among contagious diseases, which with only one single pathogen, has the highest mortality rate in the world. It affects not only the patient, but also the surroundings.

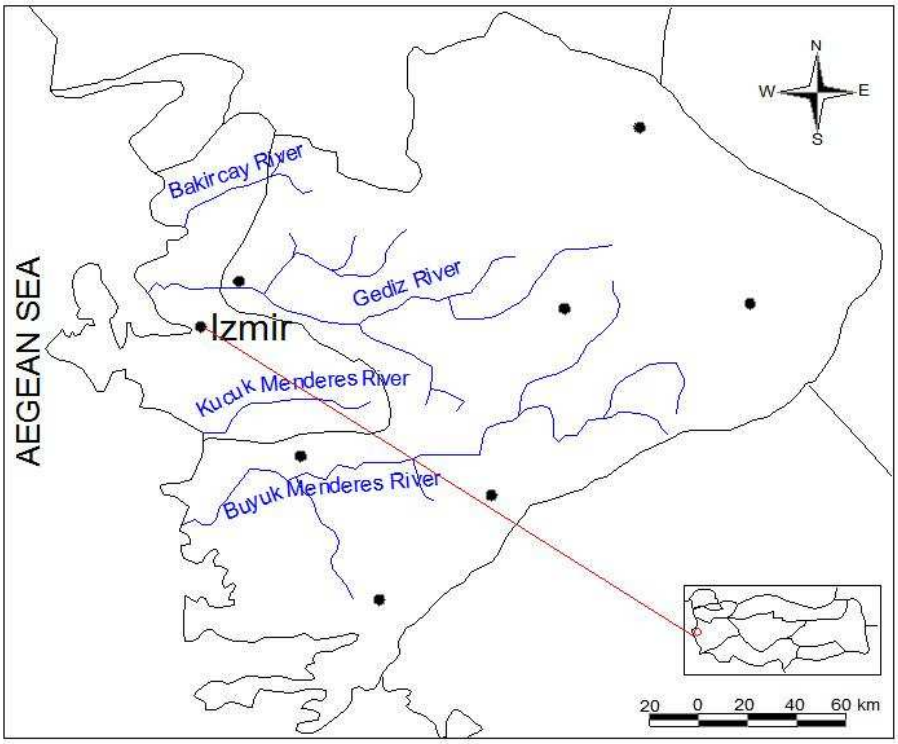

Figure 1: Location of the study area, Izmir, Turkey

2. Study Area

The study area is located along the Gulf of Izmir in the western part of Turkey. The reason for selecting Izmir is that it is the third largest city of Turkey. The population density is high as compared the vicinity area. it also has different socio-economic conditions.

3. Method and Materials

In this study, TB incidence rates (*Incidence rate,* a related concept, is the incidence divided by the number of people at risk, often expressed as the incidence per 100,000) were investigated. The tuberculosis incidence rates in Izmir's districts were mapped for the period 1994 to 2006, using Netcad 5.0. The socio-economic variables and also population density of the districts were explored and mapped.

The tuberculosis cases which had been reported to The Contagious Diseases Department of the Izmir Province Health Directorship with form 014 were investigated. Demographic, social and economic information were taken from the 2000 census, and were subsequently linked to the socio-economic variables and population density. Netcad 5.0 was used for GIS analysis.

4. Results and Discussion

Its incidence has increased and decreased over the years. It has always been a constant public health threat. TB most commonly affects the lungs but can also involve almost any organ of the body such as the kidneys, spine, and brain. TB disease can be fatal if not treated. TB is one of the contagious diseases which spread through the air, from one person to another by coughing or sneezing. However, not everyone infected with the TB bacteria becomes ill. People who are not ill have what is called a latent TB infection.

TB is currently one of the most common contagious diseases. According to the World Health Organization, TB is primarily an illness of the respiratory system. Each year about 1.7 billion people living in developing countries become infected with tuberculosis. There are more than 20 million tuberculosis patients in the world, and 8 million new tuberculosis patients are added every year. TB is responsible for the deaths of 1.5 to 2 million people in the world every year. Millions of people died from this disease in the 18th and 19th centuries. It is estimated that 1.7 million deaths resulted from tuberculosis in 2004, 2005 and 2006.

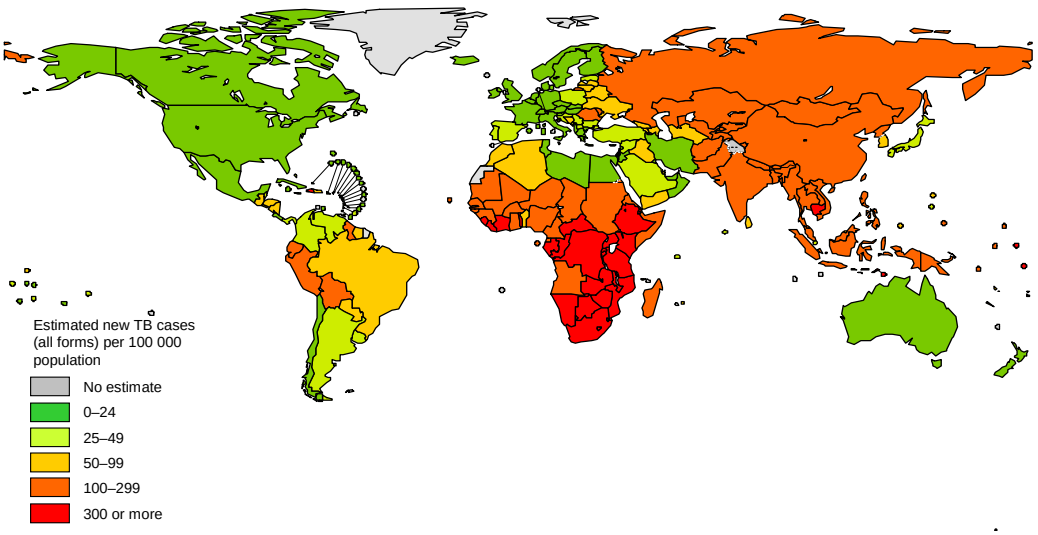

Figure 2: Estimated TB incidence rate, 2005 (WHO)

The incidence of TB is apparently still increasing, but less rapidly each year, with the exception of the African region. The WHO estimates that in 2004, the per capita incidence of TB was stable or falling in 5 out of 6 WHO regions; but growing globally at 0.6%. According to statistics from the WHO, there is a new TB patient every second in the world and 1% of the world population becomes new TB patients every year. Its incidence has increased and decreased over time, but it has always been a constant public health threat. In the 1940's some medicines were discovered to treat tuberculosis, so it slowly began to decrease. However, countries let their guard down, tuberculosis was neglected and so cases

increased. Tuberculosis affected the Ottoman Empire during the 19th century. After the First World War, TB had spread throughout Anatolia and peaked in the 1940's. Then the Turkish National Assembly approved a law concerning TB in 1949 and attempted to control this disease.

Multiple risk factors including low socioeconomic status, overcrowding, the presence of drinking establishments and immigration rates have been correlated with the geographical variation in disease incidence. Also, there are some epidemiological criteria for understanding the depth of this disease over time such as: a) TB infection prevalence, b) TB infection risk, c) TB prevalence, d) TB incidence rates.

According to figure 3 and table 1, the highest number of tuberculosis cases occurred in the most crowded districts of Izmir such as Konak, Karsıyaka, Balcova. These districts not only have a high migrant population but also contain different socio-economic conditions.

Figures 4 and 5 show the tuberculosis incidence rates which occurred in Izmir between 1994 and 2006. In this study, TB incidence rates also the changes in incidence rate of TB in Izmir were investigated.

The mapping of the disease density is significant because it may provide clues concerning its causes and effects and also the changes and rates of the disease in coming years. Also this study is an example for medical geography. When classified between districts, the incidence of TB shows a parallel tendency; it is higher in the Metropolitan Municipality of Izmir than in other districts.

Table 1: Indicence of TB in Izmir in 2006

District	Population	Case	İncidence (per 100 000)	District	Population	Case	İncidence (per 100 000)
Balcova	934447	412	44.09	Dikili	324156	95	29.31
Bornova	5311966	1962	36.94	Foca	207309	88	42.45
Buca	4208707	1979	47.02	Karaburun	86759	25	28.82
Çiğli	1482690	452	30.49	Kemalpaşa	894076	296	33.11
Gaziemir	1043205	346	33.17	Kınık	365313	97	26.55
Güzelbahçe	175775	49	27.88	Kiraz	585536	181	30.91
Karsıyaka	6167200	2099	34.03	Menderes	702794	235	33.44
Konak	10978329	5785	52.69	Menemen	1334919	449	33.63
Narlıdere	595128	297	49.91	Odemis	1637945	679	41.45
Aliağa	670831	179	26.68	Seferihisar	244188	65	26.62
Bayındır	541207	182	33.63	Selçuk	396937	99	24.94
Bergama	1297242	363	27.98	Tire	924834	325	35.14
Beydağ	184339	66	35.80	Torbalı	1112605	464	41.70
Çeşme	229433	77	33.56	Urla	451001	177	39.25
				Unknown		14	

Figures 5, 6, 7 and 8 have illustrated the socio-economic conditions (population density, illiteracy rates, unemployment rates and household size) of Izmir. According to these figures, some districts such as Konak, Balcova, Karsıyaka and Buca have high population density, illiteracy and unemployment rates. It means that the socio-economic conditions which are closely associated with the incidence of TB cases.

In this study, it was found that TB cases had increased from 732 to 1234 and the incidence rate increased from 22.75 to 26.69 between 1994 and 2006. The registered number of TB notifications in 2006 was 1,234 people. The TB incidence rate was 36.2 per 100,000.

According to data, there have been 16,218 TB patients since 1994 in Izmir. It is believed that socio-economic factors can affect the disease rate. So population density, illiteracy and unemployment rates were investigated. It was seen that some districts, especially those located in the Metropolitan Municipality, suffer from TB. Foca, Torbalı and Odemis are the other districts where TB incidence rates were high. Foca is a district where

there are military bases, so health controls are systematic. Another district that had a high incidence rate was Odemis. This situation may be related to successfully identifying the disease, or communication within the area and also with other big cities.

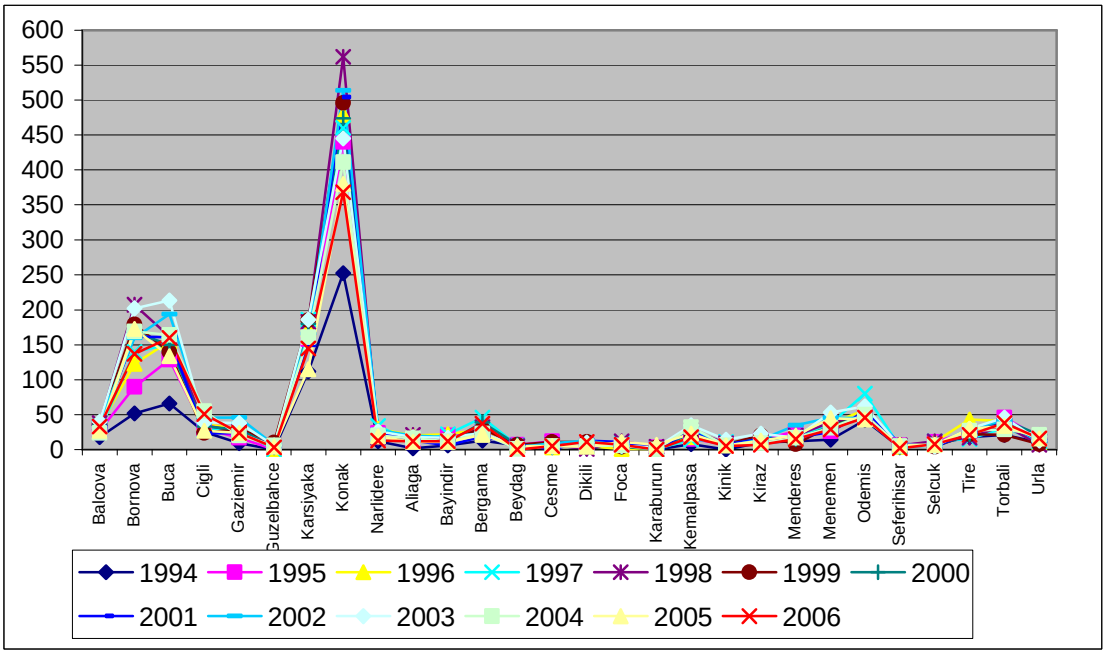

Figure 3: Tuberculosis cases in Izmir (1994–2006)

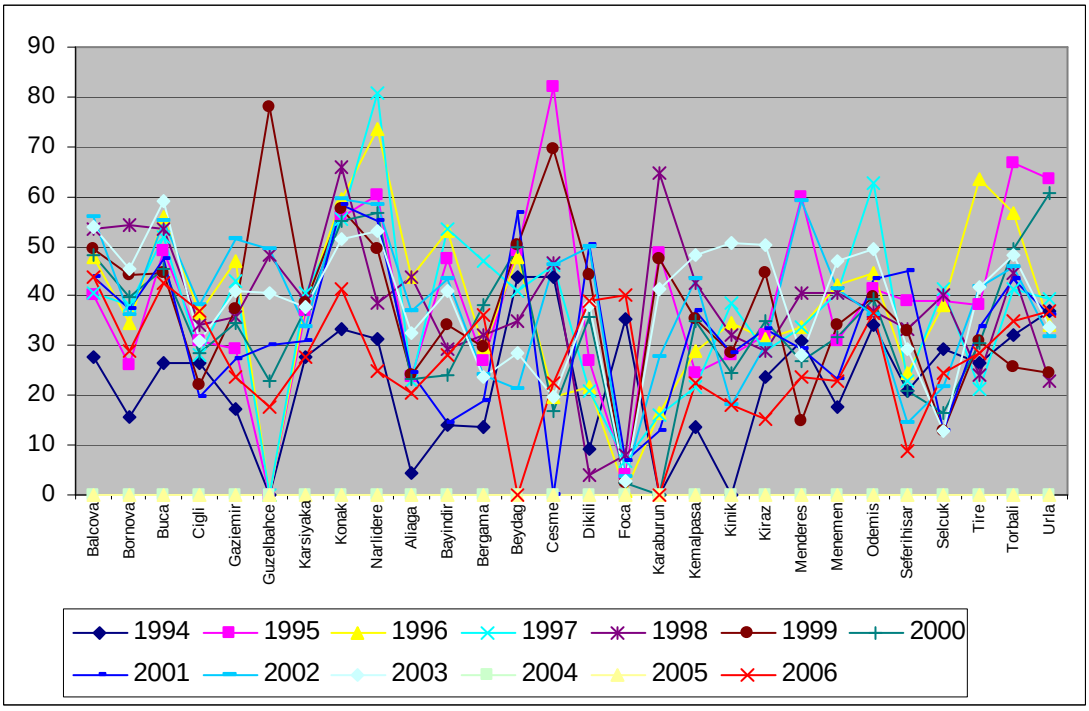

Figure 4: The rate of tuberculosis incidence (per 100 000) in Izmir (1994–2006)

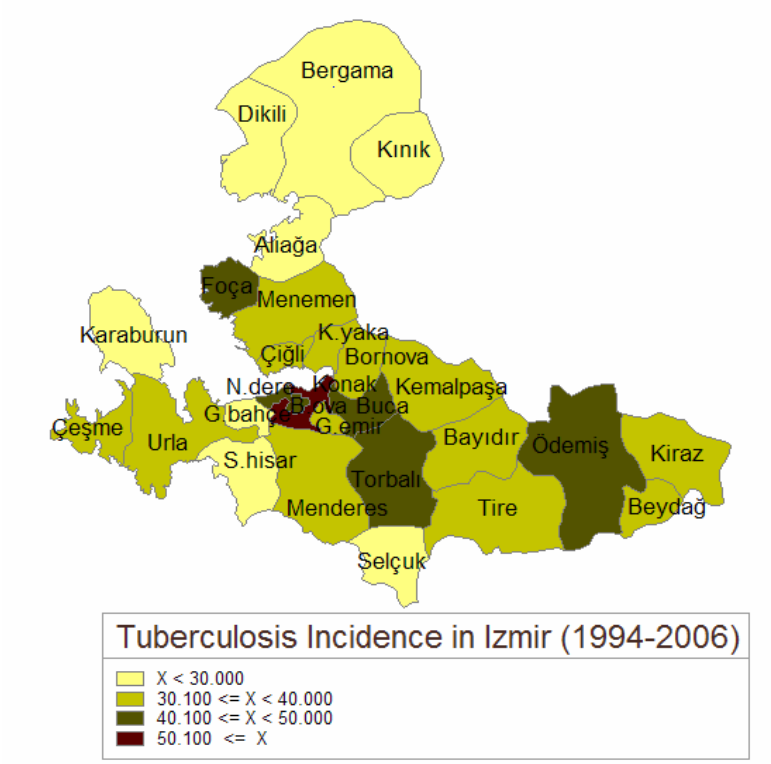

Figure 5: Tuberculosis cases in Izmir (1994-2006)

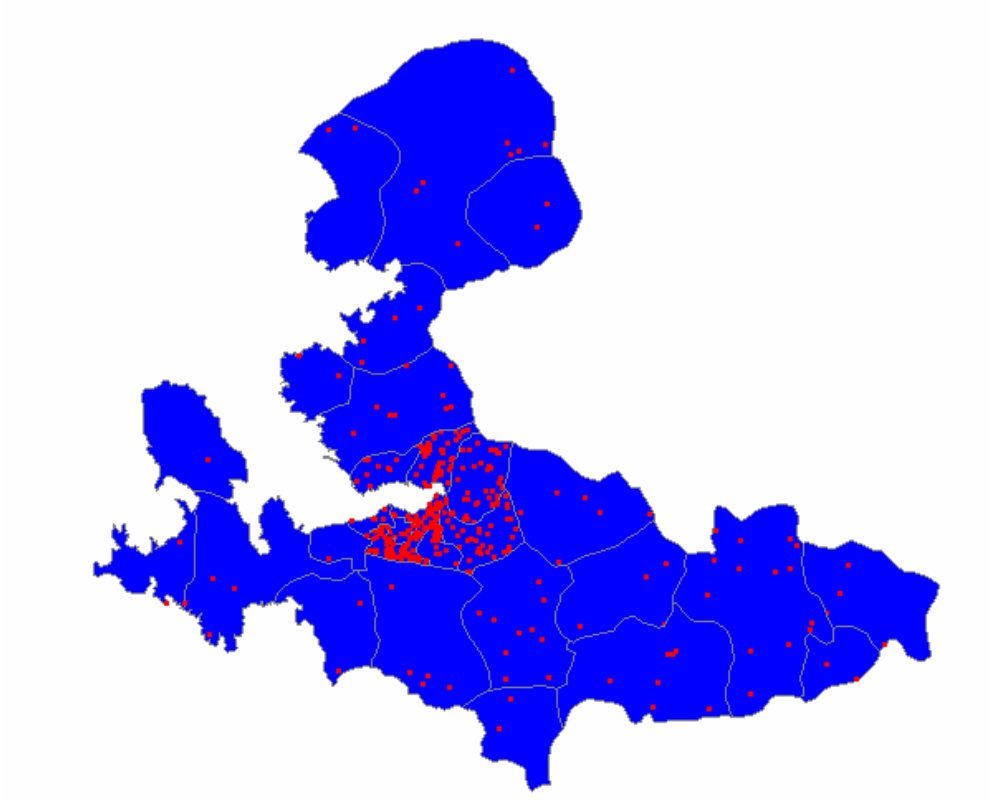

Figure 6: Tuberculosis density in Izmir (1994-2006) (1 point= 50 TB)

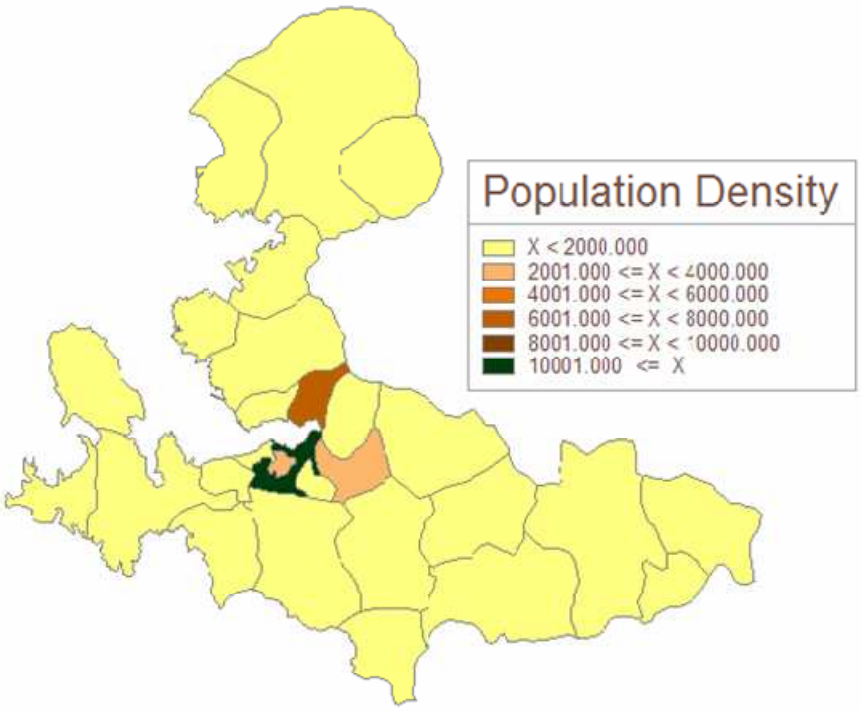

Figure 7: Population Density of Izmir

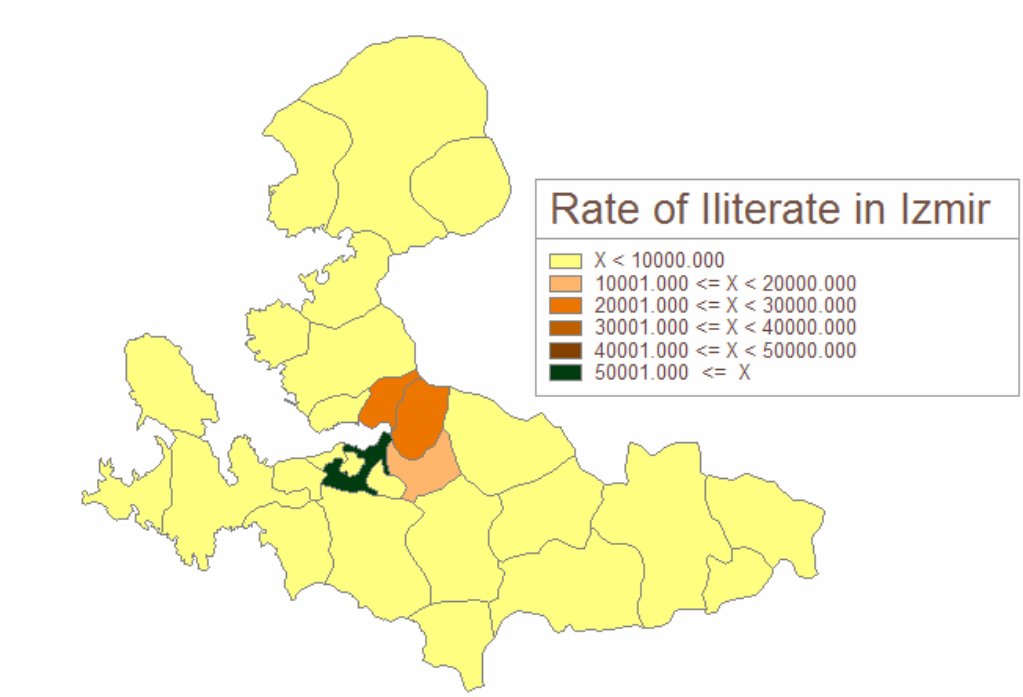

Figure 8: Illiteracy Rate in Izmir

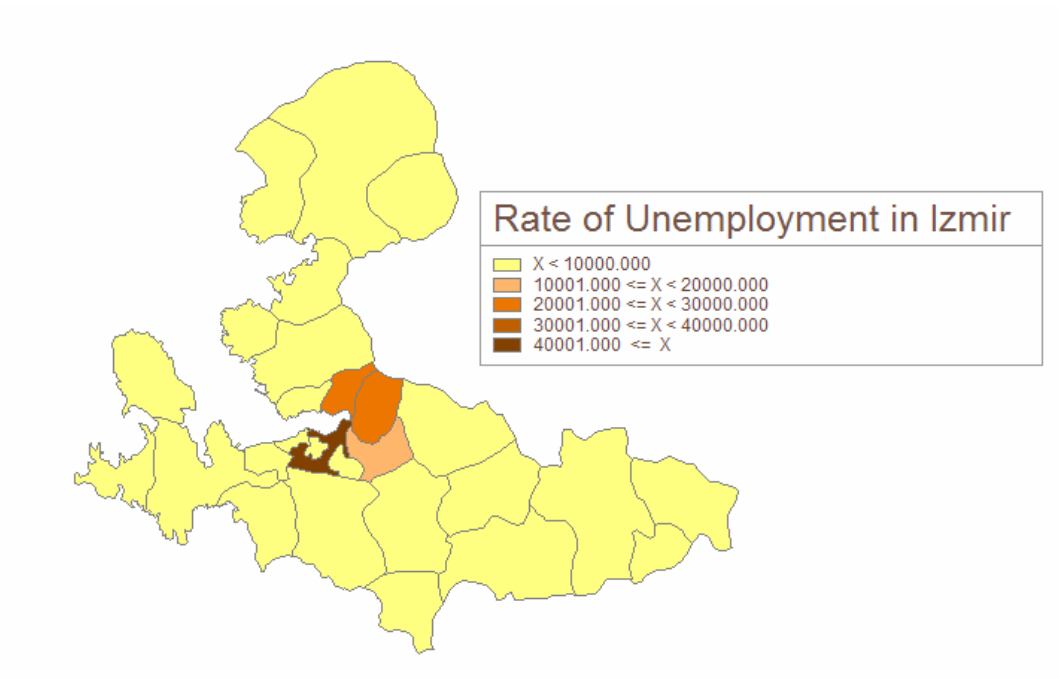

Figure 9: Rate of Unemployment in Izmir

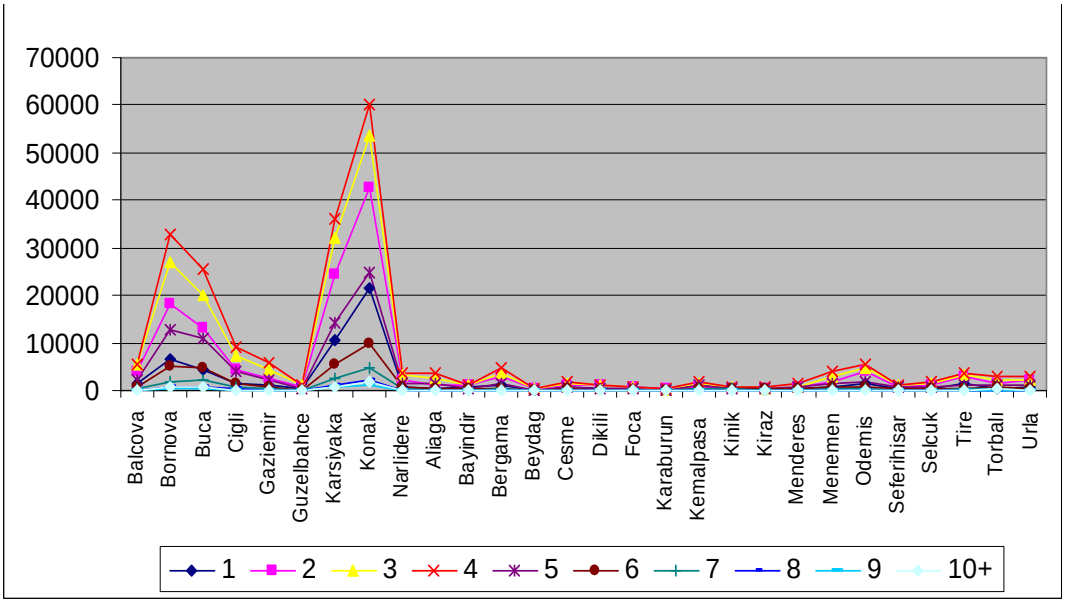

Figure 10: Household Size in Izmir

5. Conclusion

The registered number of TB notifications in 2006 was 1,234 people. The TB incidence rate was 36.2 per 100,000. The study has shown the presence of hotspots of TB in districts of Izmir province in Turkey. Geographical information systems are valuable tools for studying TB epidemiology, but have been underused for the evaluation of TB control programs. Geographical location and social conditions have played an important role in TB transmission. TB can be identified using GIS techniques via density and distribution mapping of TB incidence data. Moreover, the emerging patterns of the spread of TB, within the

different districts of Izmir over a ten-year period, may provide some guidance as to the possible trends that TB will develop over the coming years.

The main problems of geographical surveillance for a spatially distributed disease are the identification of areas with an exceptionally high prevalence, the testing of their statistical significance and to identify the reasons behind the elevated prevalence of the disease. A hotspot is an area of high response or an elevated cluster of an event. Temporal, spatial, and space-time scan statistics are commonly used for disease cluster detection and evaluation. Using GIS technology to monitor the impact of interventions on the spreading of disease within communities is one approach for tracking their impact on health.

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