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Cancer And Death Ratio Maps Case Study of Kutahya Province in Turkey

Hatice Canan Gungor
Necmettin Erbakan University, Faculty of Aeronautics and Astronautics, Department of Space and Satellite Sciences, Konya
Corresponding email: cnngungor@gmail.com

----------**ABSTRACT**----------
Nowadays, the boundaries of science disciplines all over the world are constantly evolving. Therefore, common issues arise between disciplines, which can solve them together more healthily. In this framework, Geographical Information Systems (GIS), keeping the developing technologies within the scope, is serving to a wide spectrum by constantly renewing and developing itself.
GIS is a technological system consisting of computer software and hardware that visualize and analyze the wide range of information in the geographical context. This system has almost all the features of a database management system. The core data in the Geographical Information System is necessarily related to the geographical location.
Especially in recent years, there has been a significant increase in GIS applications in medical matters. GIS supports the day-to-day operations of large-scale to small-scale public health programs, and their managerial work with the holistic perception ability that they provide through planning contributions and epidemiological maps. The relationship between medical science and GIS technology has begun with approaches that have been put forward in order to carry out the studies on medical geography more effectively. There have been many international studies on the use of GIS in medical geography.
To benefit from this technology in the field of health care, two spatial analysis approaches have been used. The first is the geographical distribution of diseases on the earth (epidemiology) and the second is the examination of the geographical distribution of medical services on the earth.
The first applications of GIS in medical fields are geographical epidemiology. The first studies are usually in this direction. However, in recent years, as the significance of medical services in the development policies of countries has risen, the distribution of medical services, which is the second approach, has also gained importance. This approach deals with the type of health facilities, their capacity, the distribution of personnel, the amount of population benefiting from health services, their structural characteristics and their expectations from medical services.
With GIS, disease mapping and healthcare organizations can be provided with a visual distribution, so that the framework of investments can be determined, and in which regions new healthcare facilities can be opened and the reasons for the diseases can be decided.
The "Turkey Health Information System" (THIS (TSBS in Turkish)) project was initiated by the Ministry of Health in 2004 in the country. With this project, the use of information and communication technologies in the field of health is supported. The GIS, which can be integrated with the Core Resource Management System (CRMS (ÇKYS in Turkish)) in the subcomponents of THIS, contributes to the management of medical services such as investment planning and emergency action plans.
Therefore, geographic distribution approach to cancer disease and mortality rates for Kutahya province was discussed in the study. Because, the planning of health services according to disease distribution and monitoring death rates has an important place in the development policy of our country nowadays.
Kutahya province, which is selected as the case region, is located in the inner western Anatolia part of Aegean Region. Kutahya lie between 38° 70' and 39° 80' north latitudes and between 29° 00' and 30° 30' east longitudes. The height of the center of the city is approximately 969 m. According to the count of 2007 HDD (Household Determination Document (ETF in turkish)), the population of the province is 558.044, and the population of the central district is 228.956. The area of the province is 11890 km2 and the population density of the central district is 88 persons per km2.
The number of cancer cases in the central district of Kutahya province in 2007 was obtained from Kutahya Provincial Health Directorate. 1/25 000 scale Kutahya City Plan, which is taken from Kutahya Municipality and Kutahya province and district maps obtained from Başarsoft were utilized. The purpose of the study is to monitor the number of cancer cases in Kutahya province regarding geographical distribution and the cancer incidence in 2007 and to visualize the death rates of the same year with thematic maps.

Cancer data were collected in 7 types. Population data for each district were determined according to 2007 HDD census. Cancer cases seen according to population were calculated as incidence and cancer maps were formed. Death data by age for 2007 were entered into the system and mortality maps were obtained.
Cancer maps provide an unusual trail of factors that affect cancer formation. GIS capabilities make it possible to conduct geographic-based studies in cancer control and epidemiology. GIS can be benefited in cancer research with general approaches such as disease mapping, geographical correlation studies, risk identification in relation to predetermined point or line sources, and defined group and grouped diseases.
In conclusion, this narrow field study can be carried out in a wider area across the country, by examining more influencing factors and by monitoring temporal changes in disease. It has been tried to demonstrate the necessity of more extensive studies with a larger database and team. Therefore, decision making mechanisms in the medical field will be provided accurate and appropriate solutions with GIS technologies, supported by inquiry and analysis.
Keywords: Medical GIS, Visualization, Application Development, Disease Mapping, Mortality Mapping.

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INTRODUCTION

Cancer maps provide an unusual trail of factors that affect cancer formation. GIS capabilities make it possible to conduct geographic-based studies in cancer control and epidemiology. GIS can be benefited in cancer research with general approaches such as disease mapping, geographical correlation studies, risk identification in relation to predetermined point or line sources, and defined group and grouped diseases. The use of GIS in the medical field has been adopted as one of the emerging technologies in recent years, making it possible for public health professionals to visualize and analyze data. It may be helpful in determining the geographic distribution and variation of diseases (eg, prevalence and incidence) and related factors, in analyzing spatial and longitudinal trends, mapping under risk populations and stratifying risk factors. It can also support resource assessment and access (health services, schools, water resources), assessing many "if" scenarios, planning and targeting, predicting epidemics and monitoring disease and interventions over time. (Boulos and dig.:2001)

In this study, the population and health census collected in discrete geographical regions were tried to be examined. In general, methods related to spatial epidemiological data have been sampled recently by Lawson et al. (1999), Elliott et al. (2000), and Waller and Gotway (2004).The disease mapping, as part of the person / place / time classic trio, has a long history in epidemiology. (Walter, 2000) Statistical evaluation and mapping of diseases have been available since the past to present (see Clayton and Bernardinelli, 1992; Molli'e, 1996; Wakefield et al., 2000 Smans and Esteve, 1992). For certain cancer sites, there are examples of disease mapping studies as well as numerous cancer atlases. (Devesa et al., 1999, eg, Kemp et al., 1985); for example: mapping studies were done by Toledano et al. (2001), the spatial and temporal trends report for testicular cancer; and Jarup et al. (2002) for prostate cancer.
Starting from such studies, population data of 13 districts of Kutahya in 2007, the thematic demonstration of the cancer cases in 7 cancer types and the death rates of 2007 will be provided thematically as the starting point. Environmental factors that may affect these diseases will be evaluated during future studies. Statistical significance levels will be analyzed with appropriate analyzes. With the examples from current studies in developed countries, disease maps will play an active role in the field of health for our country, and provide the means to understand the causes and distributions of diseases.This study has been undertaken as the pioneer of future broad statistical evaluations of diseases and environmental causes.

II. MATERIAL METHOD

1.1 Study Region

Kutahya province, which is located in the inner west Anatolia part of the Aegean Region, was selected as the study region. Kutahya lie between 38° 70' and 39° 80' north latitudes and between 29° 00' and 30° 30' east longitudes. The height of the center of the city is approximately 969 m. According to the count of 2007 HDD, the population of the province is 558.044, and the population of the central district is 228.956. The area of the province is 11890 km2 and the population density of the central district is 88 persons per km2. The position of the province in Turkey is shown in Figure 1.1.

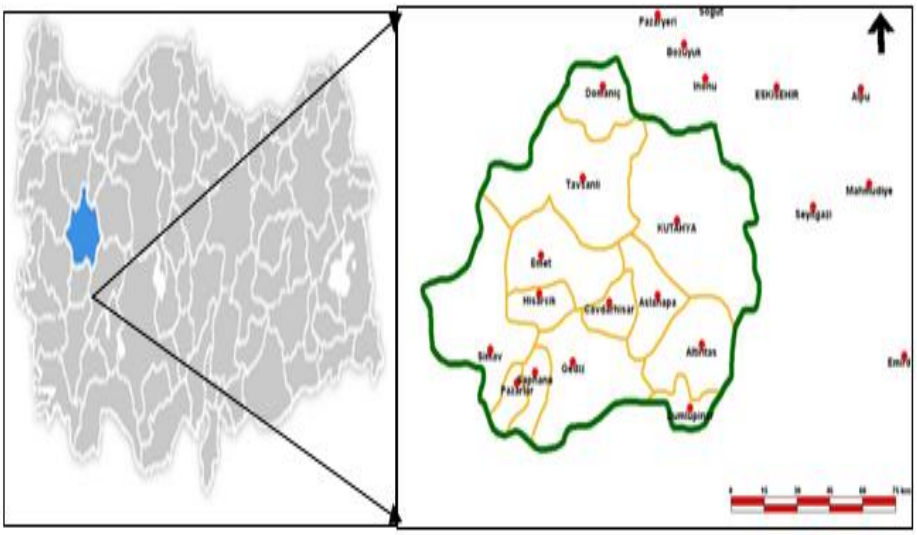


Figure 1: Location Map

1.2 Creation of Cancer Maps

The aim of the study is to analyze the distribution of cancer cases in 2007 according to the districts and if the incidence value of distribution lies between the limit values in the world.

The incidence of the disease is given in Formula 2. Thus, the distribution of cancer cases of various kinds for Kutahya province in 2007 according to the districts is shown on the thematic maps. The other thematic map has been produced with the ratios of the crude death rates taken from formula 1.

$$\textbf{1- Rough Death Rate} = \frac{\textbf{Number of Total Deaths in a Year x 1000}}{\textbf{Mid-year Population}}$$

$$\textbf{2. Rate of Incidence} = \frac{\textbf{Number of (New) Cases Starting Within the Examined Period x 100000}}{\textbf{Population at Risk}}$$

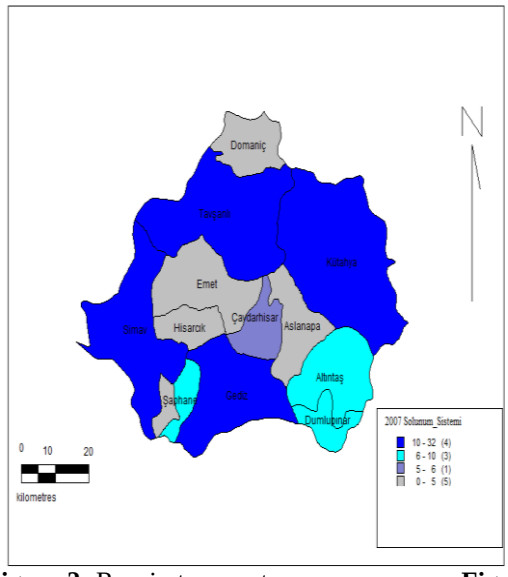


Figure 2: Respiratory system cancers

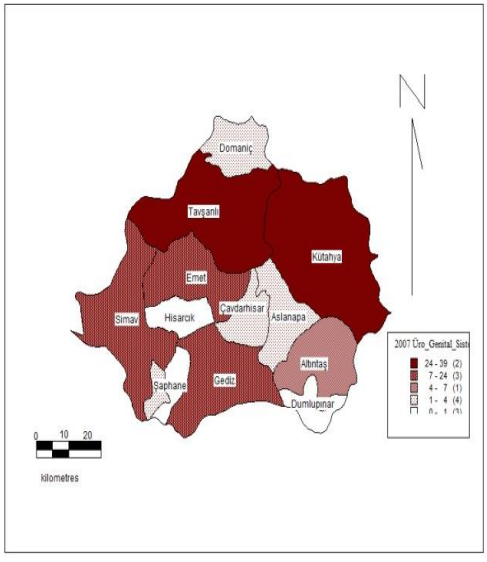


Figure 3: The number of Urogenital system cancers

Respiratory system cancer is seen intensively in Central district, Tavşanlı, Simav and Gediz districts. Urogenital system cancers are generally seen in the central district and Tavşanlı district.

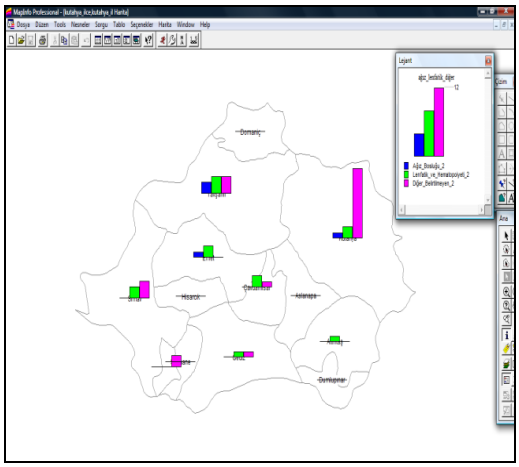


Figure 4: Other cancer types shown graphically

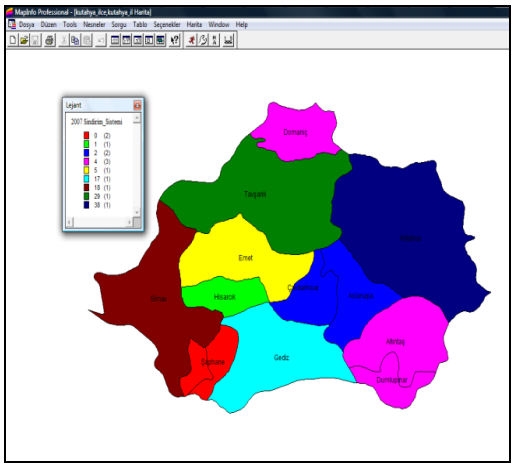


Figure 5: The number of Digestive system cancers

Digestive system cancers are seen mainly in central district and the districts of Tavşanlı, Simav, and Gediz.

1.3 Cancer Incidences

According to WHO, 150-300 people per 100,000 populations are expected to get cancer each year in the world. Thus, settlement areas with an incidence value greater than 300 are considered as risky in terms of cancer intensity. Consequently, as a result of analyzes on the generated cancer incidence map, the incidence magnitudes of the districts, classified according to the limit value stated by WHO, are shown on the Chart 1.
It is seen that this value is not exceeded in any settlement place with the cancer cases of 2007 when it is evaluated on the basis of the districts including central district of Kutahya province.

Chart 1: Number of districts falling in Incidence class intervals

Class of Incidence Size	Number of Settlement Units (District Based)
0-150	**12**
150-300	**1**
300 <	**0**

Kutahya Province Cancer Density Map and incidence rates of districts

ID	NAME	2007 (HDD)	size of the area	person per km^2	case	incidence
1401	Dumlupınar	2499	309.5	8.07431341	3	120.05
1402	Altıntaş	18708	891.2	20.991921	17	90.87
1403	Aslanapa	12 503	616.3	20.2871978	11	87.98
1404	Gediz	52 295	1265	41.3399209	56	107.08
1405	Şaphane	7316	239.8	30.5087573	8	109.35
1406	Markets	6027	143.1	42.1174004	4	66.37
1407	Hisarcik	13687	368.2	37.1727322	1	7.31
1408	Emet	24045	964.3	24.9351861	23	95.65
1409	Çavdarhisar	8025	420.7	19.0753506	17	211.84
1410	Domanic	17 295	547.5	31.5890411	10	57.82
1411	Tavşanlı	96 925	1920	50.4817708	106	109.36
1412	Simav	69 541	1505	46.2066445	62	89.16
1540	Kutahya	228 956	2461	93.0337261	180	78.62

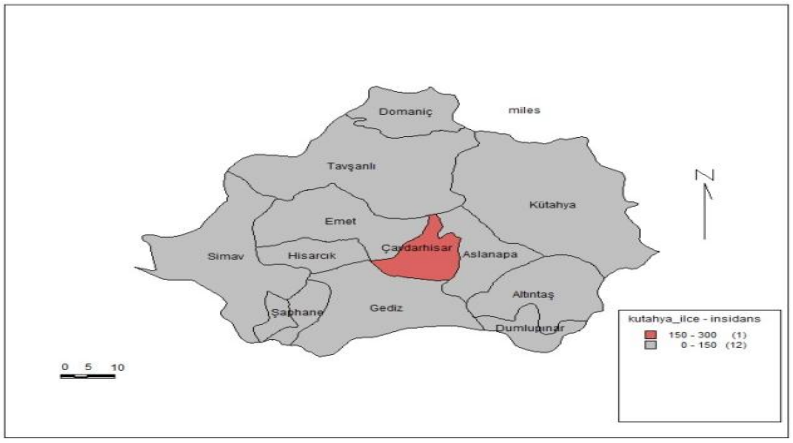


Figure 6: Cancer Density Map

According to the incidence values calculated in 13 districts of Kutahya province, there are no settlement units that exceed the number of cancer cases expected in 100.000 population. When a general incidence value was calculated for the whole province, the incidence size was found to be approximately 89. This criterion is seen as the value of cancer incidence in Kutahya Province below the expected 150-300 limit for 100,000 people. Figure 3.32 shows population density map based on the number of people per km2. The central district, Tavşanlı and Simav districts are more populous. In figure 3.33, cancer intensity map is shown. Hence, it is seen that the incidence value of Çavdarhisar district is between 150-300 limit value**.**

1.4 Death Rates

Chart **2:** Death by Age in 2007

ID	NAME	_2007_ETF_	_0_14	_15_44	_45_64	_65_	_
1.401	Dumlupınar	2.499	0	0	22	0	
1.402	Altıntaş	18.708	8	10	17	81	
1.403	Aslanapa	12.503	2	5	14	38	
1.404	Gediz	52.295	14	21	59	226	
1.405	Şaphane	7.316	5	7	3	58	
1.406	Pazarlar	6.027	2	1	7	32	
1.407	Hisarcık	13.687	2	2	3	35	
1.408	Emet	24.045	0	3	21	108	
1.409	Çavdarhisar	8.025	3	0	8	22	
1.410	Domaniç	17.295	3	6	24	80	
1.411	Tavşanlı	96.925	25	34	103	363	
1.412	Simav	69.541	19	18	55	368	
1.540	Kütahya	228.956	157	164	506	1.992	

According to the chart 2, deaths are seen more frequently above the age of 65. In the map shown in Figure 7, deaths between the ages of 15-45 are seen more frequently in the central district, Tavşanlı, Simav and Gediz districts.

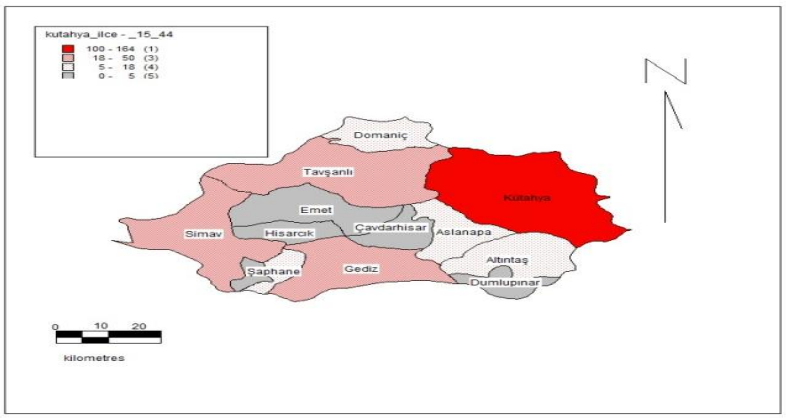
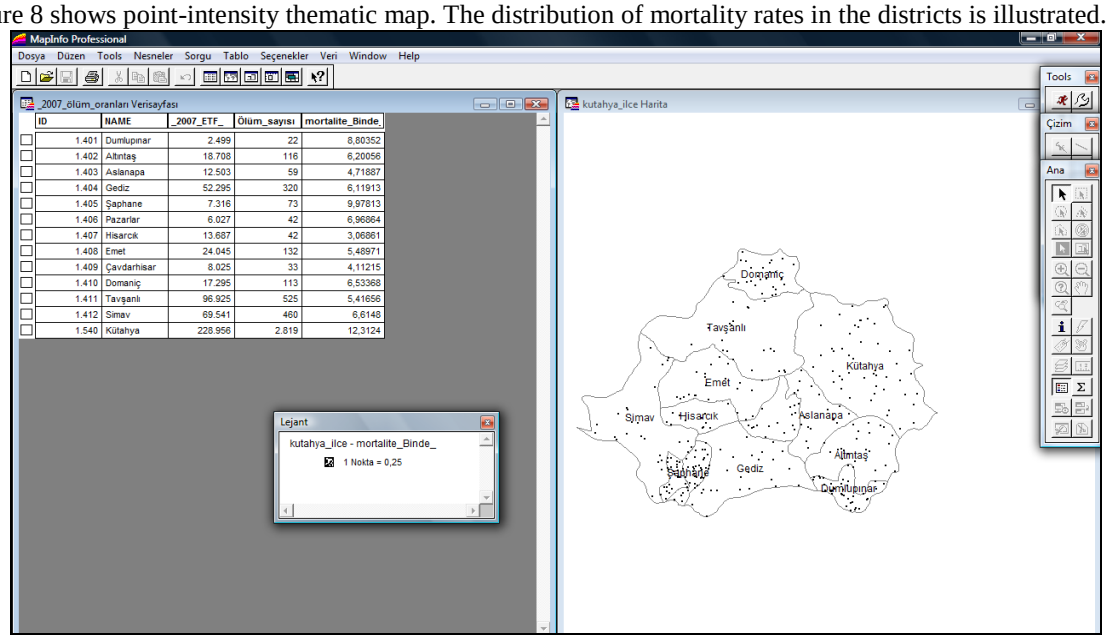


Figure 7: Adult death distribution

Figure 8 shows point-intensity thematic map. The distribution of mortality rates in the districts is illustrated.



ID	NAME	_2007_ETF_	Ölüm_sayısı	mortalite_Binde_
1.401	Dumlupınar	2.499	22	8,80352
1.402	Altıntaş	18.708	116	6,20056
1.403	Aslanapa	12.503	59	4,71887
1.404	Gediz	52.295	320	6,11913
1.405	Şaphane	7.316	73	9,97813
1.406	Pazarlar	6.027	42	6,96864
1.407	Hisarcik	13.687	42	3,06861
1.408	Emet	24.045	132	5,48971
1.409	Çavdarhisar	8.025	33	4,11215
1.410	Domaniç	17.295	113	6,53368
1.411	Tavşanlı	96.925	525	5,41656
1.412	Simav	69.541	460	6,6148
1.540	Kütahya	228.956	2.819	12,3124

Figure 8: Point Density Mortality

II. CONCLUSION

Cancer density maps were obtained by calculating the incidence criterion for cancer mapping. Distribution of seven cancer types to districts have been analyzed. In general, it is noted that the density is in settlements with a large population. Differently, the incidence was found to be highest in Çavdarhisar district. However, since it is a value below the classification, it is not considered important. The medical planning can be done more appropriately by not only verbally giving statistics but also by analyzing visual maps. In order to help those in medical service, this study was carried out with respect to "a picture tells a thousand words".

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