AN ASSESSMENT OF SPATIAL RELATIONSHIP BETWEEN LUNG CANCER INCIDENCE RATE AND QUALITY OF URBAN LIFE: IZMIR CASE

A Thesis Submitted to
the Graduate School of Engineering and Sciences of
İzmir Institute of Technology
in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

in City Planning

by
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July 2013
İZMİR

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ACKNOWLEDGMENTS

I would like to express my sincere gratitude to my supervisor Assist.Prof.Dr. Ömür SAYGIN.

I would also like to express my gratitude to my co-supervisor Assist.Prof.Dr. Çiğdem TARHAN for her sincere and objective support and criticism.

I also thank Assoc.Prof.Dr. Sultan ESER and Dr. Cankut YAKUT for their help and support. This thesis would never be realized without their assistances.

Additionally, I acknowledge my examining committee members Assoc.Prof.Dr. Semahat ÖZDEMİR, Assoc.Prof.Dr. K. Mert ÇUBUKÇU and Assist.Prof.Dr. Koray VELİBEYOĞLU for their valuable comments and advices.

Also thanks go to Soner MEŞE and all my friends for their genuine help and patience during my study.

Finally, my deep gratitude and appreciation go to my family for their help during all my life.

ABSTRACT

AN ASSESSMENT OF SPATIAL RELATIONSHIP BETWEEN LUNG CANCER INCIDENCE RATE AND QUALITY OF URBAN LIFE: IZMIR CASE

The study assesses spatial clusters of lung cancer incidences within Izmir province on the basis of districts and also neighborhood using an objective sets of quality of life indicators. Lung cancer data, approximately 18.000 cases, were acquired from the Izmir Cancer Registry Center (ICRC) between the years of 1992-2007. Cases have been confirmed in terms of accuracy by World Health Organization (WHO). As objective indicator data, point source air pollution data acquired from the Izmir Metropolitan Municipality database between the years of 1993-2007. Besides, socio-economic statistics data were obtained from Turkish Statistical Institute (TSI) regional indicators (2000,2007) and Izmir Metropolitan Municipality city health profile (2007). The datasets were used to determine whether there is a significant spatial relationship between cancer case density and environmental contamination.

This thesis uses spatial statistical models and Geographical Information System (GIS) techniques to analyze population-based cancer incidence rate. Additionally, Age Standardized Incidence (ASR) of the lung cancer was calculated. Spatial autocorrelation technique was performed to investigate local distribution of lung cancer. Results of the study suggest that spatial clusters of lung cancer were detected in geographic locations with low level environmental quality and high level socio-economic profile. Then, the results are discussed in terms of life quality and environmental quality of Izmir. The results of this study are useful for interdisciplinary researchers, epidemiological studies, policymakers and governmental agencies in terms of health and environmental assessment, regulation and control of spatial strategies.

ÖZET

AKCİĞER KANSERİ İNSİDANS ORANLARI İLE KENTSEL YAŞAM KALİTESİ ARASINDAKİ MEKANSAL İLİŞKİNİN DEĞERLENDİRİLMESİ: İZMİR ÖRNEĞİ

Bu tezde, İzmir İl'i içindeki akciğer kanseri insidansı mekansal kümelenmesi objektif bir set olan yaşam kalitesi göstergeleri kullanarak, ilçe ve mahalle bazında değerlendirilmektedir. 1992 - 2007 yılları arasında olan akciğer kanseri verisi, yaklaşık 18.000 tane olgu, Izmir Kanser Kayıt Merkezinden elde edilmiştir. Olguların doğruluğu Dünya Sağlık Örgütü tarafından teyit edilmiştir. Objektif göstergelerden 1993 - 2007 yılları arasındaki nokta kaynaklı hava kirliliği verisi; İzmir Büyükşehir Belediyesi veritabanından elde edilmiştir. Ayrıca, sosyo-ekonomik istatistik verileri Türk İstatistik Kurumu bölgesel göstergelerinden (2000 - 2007) ve İzmir Büyükşehir Belediyesi Kent Sağlığı Profilinden (2007) elde edilmiştir. Veri setleri, kanser vaka yoğunluğu ve çevresel faktörler arasında anlamlı bir mekansal ilişki olup olmadığını belirlemek için kullanılmıştır.

Bu tezde, nüfus tabanlı kanser insidans hızını analiz etmek için mekansal istatistiki modeller ve Coğrafi Bilgi Sistemi teknikleri kullanmaktadır. Ayrıca, İzmir ilçelerinin akciğer kanseri insidans hızları hesaplanmıştır. Mekansal otokorelasyon tekniği, akciğer kanserinin yerel dağılımını araştırmak için uygulanmıştır. Çalışmanın sonuçları, akciğer kanseri mekansal kümelenmesinin düşük düzeyde çevre kalitesi ve yüksek düzeyde sosyo-ekonomik profili olan coğrafi bölgelerde tespit edildiğini göstermektedir. Elde edilen sonuçlar İzmir'in yaşam kalitesi ve çevre kalitesi durumu açısından tartışılmıştır. Ayrıca tezin sonuçları, disiplinlerarası araştırmacılar, epidemiyolojik çalışmalar, politikacılar ve kamu kurumları için, sağlık ve çevresel değerlendirmeler, düzenlemeler ve mekansal stratejilerin kontrolü açısından kullanıma ve disiplinlerarası çalışma yapmaya imkan tanımaktadır.

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ASR	Age Standardized Rate
ESP	Eurepan Standard Population
EU	Eurepean Union
ENCR	European Network of Cancer Registries
GIS	Geographical Information System
ICRC	Izmir Cancer Regisrty Center
QOL	Quality of Life
QOUL	Quality of Urban Life
TSI	Turkish Statistical Institute
WHO	World Health Organization
WSP	World Standard Population

CHAPTER 1

INTRODUCTION

1.1. Background

The interpretations of goals and objectives of urban planning refer to two kinds of public goods such as fresh air, clean water and street lighting in the case of environmental factor impacts (positively and negatively impact society). The acts that cause negative environmental impacts on society should be taken into account within the urban planning process. However, negative effects of environmental factors can be reduced, but effective management of environmental factors requires a clear understanding and assessment techniques in order to develop long-term environmental policies.

Almost 2000 years ago Hippocrates noted that cultural and environmental interactions between human and nature affect human health outcomes(Meade & Earickson, 2000). Thus it is unavoidable that to understand human health effects first we have to understand the natural, social and physical characteristics of diseases that affect the humans (Vinnakota, Kemp, & Kushmerick, 2006). It is the vital point to monitor geographical pattern of diseases and to evaluate their association with the environment from the geography of health perspective(Meade & Earickson, 2000). There are major types of researches concerning the geography of health describing geographical variations in diseases and evaluating the risk of disease(Gatrell & Senior, 1991).

It has been mentioned that environmental factorsaffect incidence rate of various types of cancer(Onen, 2008). The concept of environment includes physical (soil-water and air), biological and social environments. They have an interaction with each other(The Ministry of Health of Turkey, 2008). Environment is quite important for human health. It hasbeen stated that there have been various agents which can affect human health either directly or indirectly(The Ministry of Health of Turkey, 2008).

Multidisciplinary conceptual framework of environmental quality and quality of life (QOL) has offered a theory-based choice of indicators to be able to evaluate multidimensional aspects of urban environmental quality. The evaluation of urban environmental quality leads to assess the implications of spatial and urban planning policies with respect to these dimensions (van Kamp, Leidelmeijer, Marsman, & de Hollander, 2003).

The concept QOL is based on the thinking of health. ‘Extended metabolism model of human settlements’ is a model of Newman that defines health as an indicator of livability within the ecological trend(Newman et al., 1999). Although health could be defined as a resultant of generic factors; effects of nature, quality of health care, lifestyle and the quality of physical, social and cultural environment are noticeable (Blum, 1974).

Conducted studies generally show inequalities in health are emerging according to socioeconomic status, education level, geographic location, gender, ethnic groups and age groups. Additionally, the disadvantaged groups of nomads, the homeless, refugees etc. are the ones that health inequalities are seen as unavoidable(Irgil, 2010). World Health Organization Regional Office for Europe (WHO / EURO) has started "Healthy Cities Project "at the local level to try the implication of "Health for All’ as a tool. In 1986, 11 cities were chosen in order to prove that new public health approaches based on the implication of "Health for All" principle. In 1991, the idea that Healthy Cities Project may be an approach for solving the problems in cities in both developed and developing countries has been dominated. In the beginnings of 1992 the National Healthy Cities Network reached a number composed of approximately 375 cities. In the same year, in Europe 200 cities and 500 cities around the world has been included to the "Healthy Cities Network".The first period took place between 1987 and 1992, and it was ended by being included of 35 cities to the Healthy Cities network. The second period took place between 1993 and1997. In June 2000 Conference in Athens showed that second phase has ended and third era has begun.The fourth period of the project took place between 2003 and 2008. The fourth phase had more than 70 cities in the European Network and the main themes of this period were a healthy city plan and health impact assessment.The European Network of Healthy Cities is in the fifth period that will last between 2009 and 2013. Almost 94 cities committed to fulfill the main goals and themes of this period.Izmir Metropolitan Municipality also applied to be a member of Turkish Healthy Cities Association on Jun 02, 2006 by Resolution of City Council.

Within the studies of healthy cities and environmental impacts on health, some diseases among populations become noticeable such as cancer. Cancer is a leading disease in all over the world and in also Turkey in recent years. Cancer is a general term and there are more than a hundred different types of cancer(http://www.cancer.gov/, 2011). Cancer distribution maps are important tools in health research, which allows the identification of spatial patterns, clusters and disease "hot spots" that often stimulate research to identify potential factors for locally high incidence rates. In particular, borders where these incidence rates vary abruptly may indicate areas where causative exposures change through geographic space, the presence of local populations with the impact of different cancer control methods. Advances in information technology enable epidemiologists/specialists to create detail spatial based maps and employ spatial cluster statistics to collect insights about patterns of disease. If some interesting patterns are detected after spatial clustering, subsequent studies aiming to examine the underlying risk factors, such as environmental factors, life quality and socioeconomic differences in the population, is performed by the scientists (Lin, 2011; Meliker, Jacquez, Goovaerts, Copeland, & Yassine, 2009; Weston, 2012).

Among all types of cancer, lung cancer is particularly important, because it causes nearly one third of total cancer deaths worldwide (http://www.wcrf.org, 2013). It has pointed out that cancer is the second cause of death with a rate of 22 %, after cardiovascular diseases(http://www.calameo.com/books/000713529b152e4a796d3, 2013). Additionally, cancer has been defined as which occupied the fourth rank among causes of death in Turkey during 1970s, has risen to the second rank following cardiac disease in most of the regions today (M. A. Moore et al., 2010).

Before 1991, any estimates of cancer incidence in Turkey came from a nationwide passive cancer surveillance system; it is estimated that only a quarter of all cancers were captured in this way. In 1991 the first active cancer surveillance registry was established in Izmir and later became the first population based registry of the country. Izmir Cancer Registry Center (ICRC) runs the accumulation of know-how and promotion of the cancer registration in Turkey. Following the experience of ICRC, the Turkish Cancer Registry system was established with eight cancer registries (Ankara, Izmir, Antalya, Samsun, Eskisehir, Erzurum, Edirne, Trabzon, Gaziantep, Malatya and Bursa) located in sentinel provinces of the country.

As the evaluation of various approaches to concepts of QOL, urban environmental quality, health and urban planning; the relationship between concepts come into existence as a consideration points to be highlighted. It is necessary to develop multidimensional framework including both normative and descriptive approach to understand the relations between concepts. As it is concluded that urban environmental quality influences health, the effects of environmental factors on QOL and subsequently on health herewith the role of urban planning have been the controversial issue to discuss. The main problem of this researh is to investigate a framework to understand the link between urban environmental quality and cancer incidence in Izmir case.

1.2. The Research Objective and Hypothesis

The objectives of this research are

- to gain knowledge on environmental quality indicators and related effects on health and well-being,
- to determine whether there is a relationship between environmental quality and geographic pattern of cancer cases,
- to perform spatial statistical analysis of cancer data within the scope of Izmir Metropolitan Area.

This thesis will primarily try to answer the question:

What is the relationship between urban environmental quality and health?

Sub questions are:

- What are the determinants of urban environmental quality?
- What is the relationship between urban environmental quality, QOL and human health?
- What are the QOL indicators?
- What is the vital point in mapping the spatial distribution of cancer cases?

The hypothesis of this thesis is that there is a spatial relationship between urban environmental quality and lung cancer spatial patterns.

1.3. The Methodology

While trying to understand, document and formulize the relationship between urban environmental quality and cancer, the thesis is formulized as two main steps of abstract and concrete research. While abstract research involves literature survey of theoretical background and reviews consist of World, Turkey cases and evaluations; concrete research includes extensive analysis in the context of cancer case data, output database andspatial pattern maps.

Abstract Research:

- Literature reviewis conducted to understand the basic structure of urban environmental quality and QOL with its relation human well-being.
- Literature review of smart map production containing cancer case information is conducted.

Concrete Research:

Within the framework of extensive analysis, the steps of the thesis in sequence:

1. Izmir environmental objective indicators from Izmir Metropolitan Municipality, TSI regional indicators statistics and cancer data from ICRC for province of Izmir are provided. Data entry is performed in digital environment of GIS.
2. Spatial distribution of cancer cases are monitored
3. Tables of cancer data are associated with digital based maps.
4. An appropriate database is designed by re-editing the collected cancer data for the aim of the study.
5. Objective indicators of Izmir are defined and monitored.
6. Spatial autocorrelation analysis for the cancer data is performed.
7. Specific site selection is determined by monitoring hot and cold spots of registered cancer cases that are spatially illustrated at the neighborhood level
8. Analysis and queries results are interpreted in the context of objective indicators.

Cancer data of Izmir province is documented on annual bases and database will be indexed. Statistical analyses will be performed and the relations of geographical factors and cancer data will be examined. It is aimed to generate smart maps and tabular data and to produce maps displaying distribution of cancer cases maps as an end product. To accomplish this, distribution of registered cancer cases are spatially illustrated both at the neighborhood level and at the district level within the Izmir Metropolitan Municipality depending on scale where data are available. The study area covers the entire administrative boundaries of Izmir province. ArcGIS and its Spatial Analyst modules will be used for the study.

1.4. Data, Limitations and Study Area of The Thesis

ICRC have recorded approximately 200.000 cancer data approved by the WHO since 1992. 20.000 of these data are lung cancer cases and received from ICRC to use in the study. The cancer data consists of demographic data, diagnostic method data and treatment data as attribute. The data includes also the medical records by active cancer registration system (hospitals, clinics, doctor's offices, pathology laboratories, radiation (oncology, therapy centers) and the medical centers (medical oncology centers, Nursing homes, Forensic Medical Center and death certificates).The 2000, 2004 and 2007 general census data of Izmir Metropolitan Municipality data was received from Izmir Metropolitan Municipality.The base Izmir digital datawere obtainedfrom the Basarsoft firm in May 2011. The baseline data are the boundaries of province, districts, and neighborhood – polygon data, major transportation networks –polyline data, and buildings – polygon data, hospitals – point data.

There are some limitations during the process of the thesis. These limitations are classified as cancer data limitations and digital/attribute data limitations. The main limitations are lack of or missing address data about cancer registries about cancer data. For example there are a lot of “X” street but there is no information about its districts. In Izmir Province, there are “X” streets more than once in different districts. When the address data is missing, it is not possible to be pointed the case on the map in district level. Moreover, being on a single line of the records has been caused a hard process to find to point the case on map.

The study area is Izmir Province with its 28 districts corresponded to the years 1992-2007.Nine of the Province districts(Balcova, Buca, Konak, Narlidere, Guzelbahce, Bornova, Gaziemir, Karsiyaka and Cigli) are within the Izmir Metropolitan Municipality boundary in the given time period.

This thesis will conduct research on the basic structure of urban environmental quality and QOL with its relation human well-being.The thesis will characterize geographic pattern of lung cancer incidence rate toidentify the clusters of neighborhoods with high incidence rates based on time interval cancer data and will identify objective indicators involving socioeconomic characteristics at a county level for the Izmir Province. Identifying that a specific kind of pattern is likely to occur in a certain regionunder a certain set of conditions allows future trends to be predicted.This study would utilize the mapping features of GIS to create and analyzemaps of cancer pattern.The results from this study serve as the basis for further assessment of spatialassociation between lung cancer incidence rate and environmental factors would help publichealth managers and planners in regulation, control and monitoring of environmental contamination and to better allocate resources, and manage health carefacilities and its services.

1.5. Thesis Organization

The organization of this thesis is as follows:

Chapter 1 introduces background of the thesis, the hypothesis and research objectives, additionally; data sources and limitations have been defined.

Chapter 2 describes health, QOL, environmental quality, urban planning and information technology concepts. The subsection of Chapter 2 contains the subjects of connections between health and urban planning, the role of GIS in environmental health researches. On the other hand, cancer statistics of the World, Turkey and Izmir is examined in Chapter 2, also, “cancer registry” concept is defined and ICRC has been introduced as data provider.

Chapter 3 implements study area, data definitions and methodolgy parts of the thesis. Additionally, research data are mentioned in this chapter. Data and its limitaitons are also discussed. The methodology contains abstract and concrete research parts.

Chapter 4 presents the spatial point pattern of lung cancer cases in Izmir. Also, incidence statistics and spatial autocorrelation of the lung cancer are calculated. Chapter 5 is ended with objective and subjective indicators of Izmir.

Chapter 5 represents briefly summarize of the research and concludes. The recommendations and need of future studies for the improvement of efficiency and reliability of the used methods are suggested.

CHAPTER 2

HEALTH, QUALITY OF LIFE, ENVIRONMENTAL QUALITY, URBAN PLANNING AND INFORMATION TECHNOLOGIES

The WHO emphasizes that public health is not just a matter of health centers, amongst other influences, for example, the planning/design of land has a basic role. A range of diseases, respiratory problems, diabetes, mental illness and some forms of cancer occur depending on factors mediated by urban planning. Initiatives such as Healthy Cities that was started in 1988 by WHO and Sustainable Cities Programme of UN-HABITAT/UNEP seek to improve the physical, mental, social and environmental well-being of people living in urban areas (Barton & Grant, 2006).

The concepts of environmental quality and quality of life with respect to housing, spatial planning and local environmental policies have become current issues since increasing problems such as increased road traffic, socio-economic deprivation and inequities in health and health- care accessibility in large cities. Recent reviews show that there is no general conceptual framework in relation to well-being, any comprehensive system to measure and evaluate aspects of environmental quality(Irene, Kees, Gooitske, & Augustinus, 2005; Liang, 2008; van Kamp et al., 2003).

Livability, living quality, living environment, quality of place, residential perception/satisfaction, quality of life and sustainability conceptscan be overlapped; however, these concepts are often contrasted each other. Each of them has their own origins in variety of researches of health, safety, well-being and urban physical environment (van Kamp et al., 2003).

In this section, the concepts of health, quality of life, environmental quality, urban planning and information technologies are discussed. The differences between QOL and environmental quality are defined in terms of health and healthy cities. Information technology based health studies are explained both in Turkey and in the World. On the other hand, cancer statistics of the World – Turkey and Izmir are presented and a short brief is mentioned about Izmir Cancer Registry and its organizational structure.

2.1. The Concepts of Quality of Life And Environmental Quality

QOL was defined as it relates to *place* which corresponds to the geography or environments of individuals and groups of individuals such as households, neighborhoods and communities by (Pacione, 2003c). (Maantay & Mclafferty, 2011; Marans & Stimson, 2011) was defined QOL as the human satisfaction from surrounding and physical conditions (scale-dependent and affects the behavior of people). WHO – QOL Group (1993) was explained QOL as an individual's perception of his/her position in life in the context of the culture and value systems in which he/she lives and in relation to his/her goals, expectations, standards and concerns. QOL in a sustainable development has a holistic concept that includes economics development, social vitality and environmental health subjects(Pinter, Hardi, & Bartelmus, 2005).Additionally, QOL concept refers two concepts, the first one is the conditions of the environmentin which people live, (air and water pollution, or poor housing), and the second one is some attribute of people themselves (such as health or educational achievement)(Marans & Stimson, 2011; Pacione, 2012).

Environmental quality concept was defined as the consequence of the quality of composing parts of a given region, however, more than the sum of parts, it is perception of a location as a whole. Nature, open space, infrastructure, built environment, physical environment amenities and natural resources are the composing parts. They have their own characteristics and quality(RMB, 1996). The concept of environmental quality was explained as an important part of the broader concept of QOL such as health and safety in combination with aspects (RIVM, 2002).

In the context of manifestation of concepts as environmental quality and quality of life, it is concluded that they are not unequivocal and they are developing concepts. Some researchers conclude about the lack of uniformity within the developing concepts(A. Szalai, 1980; G. Szalai & Vargahaszonits, 1980). Different theories are related to the various aspects of environmental quality, this concept is defined as multidimensional. However, some claims tell that it is not really possible to define properly this multidimensional concept(J. Moore, 2000). In the discussion of theoretical approaches, a distinction has been made between theoretical and empirical approaches. While theoretical approaches explain hypothetical relations, emprical approaches represent factual relations between the different concepts. The variety of approaches in the literature indicate that there are many ways to conceptualise themes in terms of environmental quality and quality of life concepts. The different models representing environmental quality are (Pacione, 2003c; van Kamp et al., 2003):

- Human Ecology
- Quality of Life
- City Planning Approaches
- Social Indicators
- Satisfaction Research
- Transactional focus

The general review of models say that the concepts overlap and they refer to the person-environment relationship. Hereby physical, social, economic and cultural features of environment are defined that some of those are related to the environment directly, while others are related to the person. Different models are context dependent in terms of object, perspective and time-space frame.

The main theme is indicated as the interaction between environmental dimensions and human reacts to those in different approaches. However, approaches differ according to the dimensions of (Marans & Stimson, 2011; Pacione, 2003a):

- Domains
- Geographical scale
- Indicator type
- Time-frame
- Context dependency

The importance of the public health issue and its necessity into the planning process was emphasized by Dempster (Dempster, 2008). Also public health professionals specified that environmental quality and public health should be involved into the decision-making process(Liang, 2008; Northridge & Sclar, 2003; Sein, 2005). The influence of the built environment on mental and spiritual healthapproachesproposed bysome researchers (Alexander, Memiah, Henley, Kaiza-Kangalawe, & Shumbusho, 2012). They also had arguments for and against physical determinism. the health was also defined as a complete range of physical, mental and social aspects of well-being (van Heck & den Oudsten, 2010).

2.2. Environmental Quality of Life

The quality of the urban environment and its effects on QOL is an issue that researches have been interested in for a long time. A range of issues in terms of urbanization such as open space, pollution, the cost of pollution, the main resources and transportation have been mentioned by the scientists (Cicerchia, 1996; Cummins, 2000; Pacione, 1990).In the context of land-use planning, environmental quality is defined as a kind of approach through the protection and restriction mechanisms of the planning issue. Also the relationships between environmental indicators, shape and size of cities have been examined by the scientists (Cicerchia, 1996; Pacione, 2003b). Besides those researches, some work has examined the relationship between quality of environment and socioeconomic attributes of the communities(Blum, 1974; Leyden, 2003; Thomas, 2012).Across the different urban regions, quality of urban life (QOUL) is a varying concept depending on the different policies and actions of local governments. The perceived QOUL changes through the different level of scales, thus priorities, restrictions and planning interventions change across regions.Approaches to environmental quality differ from QOL in (Maantay & Mclafferty, 2011);

- Scale
- The manner in person-environment relation (human ecology, independent entities, transactional approaches)
- Objective attributes and subjective perceptions
- Determinants or indicators
- Constant or variable (in place, time, person and culture)
- Methods to measure the effects of exposures on environmental quality
- Threshold values in exposures (air, noise, safety) in relation to environmental quality
- The capacity for counterbalancing environmental exposures.

2.2.1. Theories of urban impact

Urban-environmental relationship enables urban planners to be aware of the conditions of urban life. These are defined as air and water quality, sanitation, preservation of green space, density of people, noise, transportation conditions (Ullman, Metzger, Kuzel, & Bennett, 1996). QOUL is defined as the relationship of urban groups and political-institutional system which provides activities carring out and also involving people within urban processes(Northridge & Sclar, 2003; Pacione, 2003a, 2003c). There are three components of urban life quality:

- The demand consisting of objective requirements characterized within a cultural context and the subjective requirements represented by social preferences and personal wishes,
- The supply consisting of material and non- material resources that represent regional and urban properties and services, objective needs and symbolic resources,
- The relationship between the mentioned requirements and the supply.

QOUL is assessed with an evaluation methodology which makes reviews and integrates urban systems, natural resources, housing, environment and their regional locations. Urban Life Quality Model is structured from different components which are disaggregated in urban services and equipment and urban-environmental aspects. Each of them is composed by different levels of integration, corresponding to: infrastructure services, sanitation services, communication services, social services, urban aspects and environmental aspects(Cummins, 2000).

Pacione mentioned five major theoretical approaches which have efforts to explain the impact of urban environments on the living(Pacione, 2003a). These theoretical approaches are based on principles of:

a. human ecology,
b. subcultures,
c. environmental load,
d. behavioural constraints,
e. behaviour settings.

Each of the theories identifies a particular aspect of urban life and so contributes to an overall understanding. These approaches are integrated into a overall model indicating the concept of stress defined as increased wear and tear in the body as a result of attempts dealing with environmental effects.They have been identified by Campbell (J. Campbell, 1983):

a. cataclysmic events—for example, geophysical hazards;
b. ambient stressors—for example, air and water pollution;
c. stressful life events—for example, death in the family;
d. daily hassles—for example, noisy neighbours.

Against different approaches that each are differentiated as conceptual, descriptive and normative approaches to environmental quality, it is evaluated that construction a uniform multidisciplinary framework is important in terms of accumulation of knowledge. This leads to study with different disciplines in a mutual inspiration.

The question of the usefulness of the measurement of human well-being or quality of life in favor of applied researches has central importance in the current environment. Outputs of the especially geographers' quality of life studies to social scientists, local governments and policy makershave been identified as (Pacione, 2003b):

- "production of some baseline measures of well being against which we can compare subsequent measures and identify trends over time;
- knowledge of how satisfactions and dissatisfactions are distributed through society and across space;
- understanding the structure and dependence or interrelationship of various life concerns;
- understanding how people combine their feelings about individual life concerns into an overall evaluation of quality of life;
- achieving a better understanding of the causes and conditions which lead to individuals' feelings of well being, and of the effects of such feelings on their behaviour;
- identifying problems meriting special attention and possible societal action;
- identification of normative standards against which actual conditions may be judged i order to inform effective policy formulation;
- monitoring the effects of policies on the ground;
- promoting public participation in the policy making process"

In health-related environmental quality research, there is a concluded need to develop improved epidemiological, spatial and statistical methods for assessment of relationships between environment and health. Spatial epidemiology, also called medical geography is a specialization within geography that deals with the spatial aspects of health and healthcare assessment. The goal of medical geography is to improve the understanding of various factors that influence the health of individuals and populations(Meade & Earickson, 2000). The foundation of medical geography is the idea that health is linked to a place or location.

2.2.2. Impacts of Environmental Factors

Based on the literature review on impacts of environmental factors, four important impacts could be discerned, with sufficient scientific evidence. These are: air pollution, noise, the absence of green space as a restorative environment and the lack of physical activity(Guajardo, 2008). For other impacts the effects on health and well-being have limited evidence, the spatial component is less pronounced or the spatial differentiation at a neighborhood scale is unsure. Among these non-included impacts are the lack of social interaction (Leyden, 2003), soil pollution(Vrijheid, 2000), electromagnetic fields (Roosli, 2008), the urban heat island effect (Tan et al., 2010) and unhealthy food environments (Rose & Richards, 2004).

Air pollution is definitely one of the most important environmental impacts at a local scale. The local differentiation is mainly due to the spatial organization of roads and the accompanying traffic. Also industry can contribute to local air pollution but little research focuses on this aspect. The relation between air pollution levels and roads has been investigated extensively. A lot of studies show that traffic intensity and/or distance to major streets or highways are important predictors of differences in measured pollutant concentrations, for NO2 (Zhu, Hinds, Kim, Shen, & Sioutas, 2002), PM2 (Mallant et al., 2010), (ultra)fine particles (Zhu, Hinds, Kim, & Sioutas, 2002), CO (Zhu, Hinds, Kim, Shen, et al., 2002), benzene (Mallant et al., 2010) and ozone (Kerkhof et al., 2010).These relations indicate that the measured pollutants are related to vehicle exhaust emissions.

For most traffic volumes and pollutants, the major decrease in traffic-based pollutants occurs in the first 100 meters and then levels off somewhat after 150 meters (Zhu, Hinds, Kim, Shen, et al., 2002). However, until 1000 meters of a highway a contribution of the road to local air pollution can be measured (Mallant et al., 2010). Today there is sufficient scientific evidence to conclude that living alongside busy roads is less healthy than situations with a bigger distance between the home and major roads. The most important and most described health effects are in the field of the respiratory system, with increased respiratory symptoms, lung growth deficits and allergy development in children. There was an association between high vehicle traffic and chronic respiratory symptoms like cough and wheeze in children or asthmatic symptoms and/or asthma hospitalization(Guajardo, 2008). Recent researches by (Gehring et al., 2010; Mallant et al., 2010) provide further evidence that traffic-related air pollution exposure may contribute to the development of asthma in children, and not only aggravates existing symptoms. Some cross-sectional studies in Europe have shown that deficits in lung function growth in children – associated with morbidity and mortality in adulthood (M. Brauer et al., 2008; Knuiman, Divitini, Welborn, & Bartholomew, 1996) are related to residential exposure to high (truck) traffic (Brunekreef et al., 1997; Gauderman et al., 2007). A highly cited research of (Gauderman et al., 2007) showed that pronounced deficits in attained lung function at age 18 years were recorded for those living within 500 m of a freeway, for both asthmatic and non-asthmatic children, thus giving evidence for adverse effects of trafficexposure on otherwise healthy children. Associations between distance to the nearest main road and the risk of allergy development and exacerbation of allergic reactions have also been demonstrated (M. Brauer et al., 2003; Ishinishi, Kuwabara, Takaki, & Nagase, 1988; Kramer, Koch, Ranft, Ring, & Behrendt, 2000).

The assumption that increased mortality is primarily associated with a higher prevalence of *atherosclerosis* (the hardening of arteries) and *coronary disease* is supported by the research of (Hoffmann et al., 2007), who found that long-term residential exposure to high traffic is associated with the degree of coronary atherosclerosis, and (Gan et al., 2011), who observed an association between exposure to road traffic and adverse cardiovascular outcomes.It is clear that the closer to a road people live, the higher the increase in adverse health effects, but there are no studies available that give evidence about an acceptable distance or a mathematical relationship. Each choice for an 'acceptable' distance between residential location and major roads or highways is not based on thresholds of health, but on the societal acceptability (Mallant et al., 2010).

As stated by Glick (Glick, 1982), the presence of distinct geographical variation in the occurrence of a cancer indicates the influence of localized environmental factors. By using statistical models to demonstrate a pattern of these cancer incidences in Izmir province, areas where there are distinct geographical variations or clustering would indicate an association with environmental factors.

The factors that increase having lung cancer are concluded as tobacco smoke, air pollution, such as asbestos, beryllium,cadmium, chloromethyl ethers, chromium compounds, coal products, mustard gas, nickel compounds, radon, uranium, vinyl chloride; and diesel exhaust. Other risk factors include radiation treatment to the lungs;

personal and family history; genetics; diet and vitamins (Forastiere, Perucci, Arcà, & Axelson, 1993; Guajardo, 2008; Sasco et al., 2002).

Recent literature on lung cancer and environmental pollution also mentioned about inorganic particle pollution such as arsenic, asbestos, chromium, nickel, beryllium, cadmium; sulfurdioxide; nitrogen oxides; fine particulates; ozone; radionuclides, gaseous and particulateorganic species, including benzene, PAHs, benzene soluble organics; and diesel exhaust (Beeson, Abbey, & Knutsen, 1998; Lee et al., 2002).

It is confirmed that making an assessment of a long-term exposure to air pollution is essential in order to understand the lung cancer etiology. There are many studies assessing the relationship between long-term exposure to fine particulate air pollution and cancer mortality(Beeson et al., 1998; Lee et al., 2002; Nyberg et al., 2000). They show that a long-term exposure to fine particulate; it is concluded specifically an exposure to combustion related fine particulate, nitrogen oxides, sulfur dioxides, diesel exhaust and metals is an important environmental factors increasing the risk of lung cancer and lung cancer mortality. It is concluded that the primary sources of many organic and inorganic compounds are oxidants and acids include combustion of fossil fuels for power generation or transportation and also radionuclides are being released into the environment from mining operations and from fuel combustion (Guajardo, 2008).

It was reported in a study focusing on exposure assessment of particulate matter (PM10) and sulfur dioxide between nonsmoking adults(Beeson et al., 1998). Additionally, it has been worked on investigation of relationship between exposure to sulfur sulfur dioxide in the pulp and paper industry and a lung cancer(Lee et al., 2002).The study concluded that there is an increased lung cancer risk among exposed rather than the unexposed workers. It was also emphasized that asbestos, diesel exhaust, and other combustion products caused lung cancer(Guajardo, 2008).

The relationship between lung cancer and exposure to air pollution such as nitrogen oxides, sulfur dioxide, coke oven emissions,containing benzene-soluble fraction of total particulate matter is revealed by (Tango, 1994) and (Redmond, 1983).

In studies of lung cancer pattern, it is mentioned that there are differences in patterns of lung cancer among different genders and different age groups. It is expressed to higlight the specificity on the individual and the spatial context of the studies that corresponding proximity to industry, smoking, occupational exposure or socioeconomic factors depends on ages of individual(Guajardo, 2008). It has been mentioned that for men, a weak corresponding with proximity to industry at younger ages reversed at older ages, at the same time for women under 75 years of age the association between raised lung cancer mortality could not be explained by smoking, occupational exposure, or socioeconomic factors. Table 2.1. show the pollutants associated with lung cancer by the researchers (Beeson et al., 1998; Forastiere et al., 1993; Lee et al., 2002; Nyberg et al., 2000; Tango, 1994). Additionally, Figure 2.1 is presented that health problems investigated for possible links with built environment. That diagram developed by (Lavin T, 2006) in order to show how built environment affects health.

Table 2.1. Pollutants associated with lung cancer

Pollutant	**Source**
1,2-Dichloroethane	Industrial processes,
	Gasoline
Arsenic compounds,inorganic*	Industrial processes: by-product of the smelting process for many metal ones;
	Pesticides;
	Smoking
Asbestos*	Occurs naturally, but much of its presence in the environment stems from mining and commercial uses, and from sourcessuch as building materials and vehicular brake linings
Benzene*	Industrialprocesses, Gasoline,Cigarette smoke
Beryllium	Industrial processes
Cadmium	Industrial processes
Chromium compounds*	Industrial processes
Dioxins*	By-products of industrial processes such as bleaching paper pulp, and chemical and pesticide manufacture;By-products of combustion activities such as burning household trash, forest fires, and waste incineration
Dichloromethane	A result of the manufacture, use, and disposal of the chemical
Fine particulates*	Industrial processes,
	Transportation
Naphthalene	Burning of wood, tobacco, or fossil fuels,
	Industrial discharges,
	Moth repellents
Nickel compounds*	Industrial processes
Polycyclic aromatic hydrocarbons (PAHs)*	Incomplete burning of coal, oil and gas, garbage,
	Diesel exhaust
Radionuclides*	Fuel combustion, mining operations
Radon*	Is a naturally occurring radioactive gas.
	Is also produced during mining of uranium and phosphate, and from coal combustion
Trichloroethylene (TCE)*	A result of the manufacture, use, and disposal of the chemical

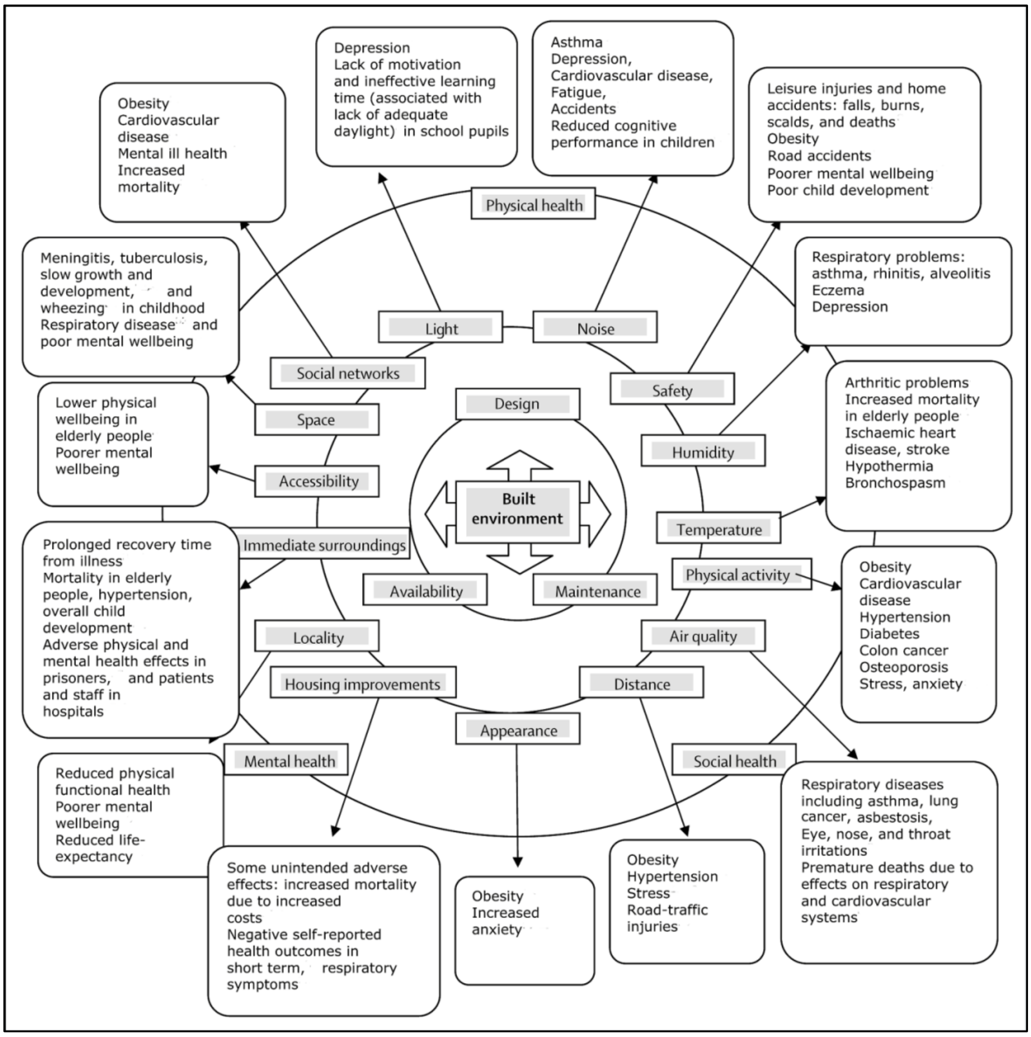


Figure 2.1. Health problems investigated for possible links with built environment

2.3. Urban Planning and QOL – Environmental Quality Relation

The models in human ecology approach draw a holistic framework including biological, epidemiological anthropological, psychological and sociological perspectives which are combined. In this framework, while livability is explained as an outcome of the interaction between the physical and social domain, sustainability is as an outcome of the interaction between physical and economic domain. Human ecology approach defines the quality of life as the interaction among physical, social and economic domains (Lawrence, 2001).

The city planning approaches imply the urban planning field sets visions rather than empirically supported theories. The vision is consist of the required principles and the quality of the urban environment. Livability, spatial character, connection, mobility, diversity and personal freedom are defined as significant dimensions within the approach. With respect to these elements, physical form criteria of the cities are considered in relation to community quality (Smith & Huang, 1995).

In the choice of indicators, research goals are the basic factors that lead the process (Cicerchia, 1996). In the literature, the general consensus is that both objective and subjective indicators are required in the studies of the person-environment relationship (Cummins, 2000). However, it is concluded that choice of indicators depends on whether the aim is scientific or political. While subjective indicators demonstrate the well-being and the satisfaction of an individual and what people considers is important; objective indicators are required for features of the environment. Subjective indicators contribute to the evaluations of people to their surrounding environment. Objective indicators are necessary for assessment of the aspects of the environment (van Kamp et al., 2003).

The issue of causality is the another theme that is encountered. The relationship between environment and person is defined as a transactional process thus it is hard to define causality(Cummins, 2000; van Kamp et al., 2003). Events and also behaviour can be causality issue influencing the environment. There are three approaches, dealing with the aspects of causality, that are discerned as economical, sociological (normative) and the psychological (subjective) approach(Lawrence, 2001). On the basis of these approaches, respectively economic welfare developments related to well-being and perception of people about their physical and built environment are generally conducted.Quality has context dependent definitions, social or cultural and it varies in time (Lawrence, 2001; Pacione, 2003b).

Brown defines environmental quality generally as a field that derives its values from community, policymakers, architects, urban planners, environmental planners(Brown, 2000). The expected impacts of quality of life has played an active role in the social acceptance of decisions and plans(Andre & Bientondo, 2002). Figure 2.2 shows a health map for local human habitat defined (Barton & Grant, 2006), based on public-health idea (Whitehead & Dahlgren, 1991). Additionally, Figure 2.3 presents ahealth map for urban planners (Barton & Grant, 2006) based on public-health idea(Whitehead & Dahlgren, 1991).

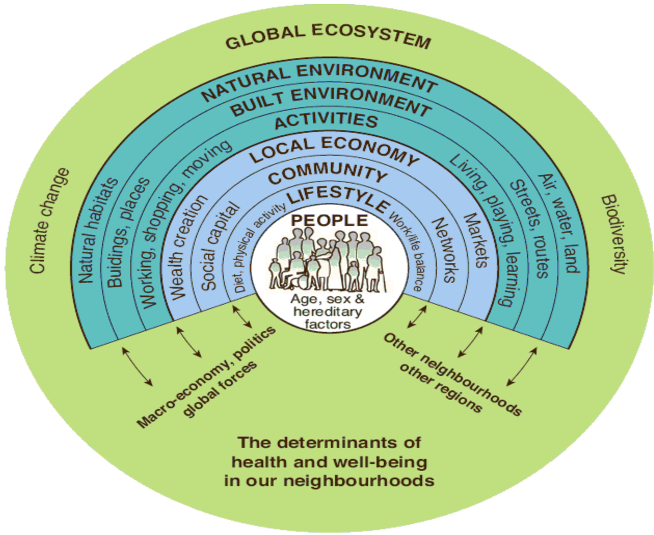


Figure 2.2. A health map for local human habitat

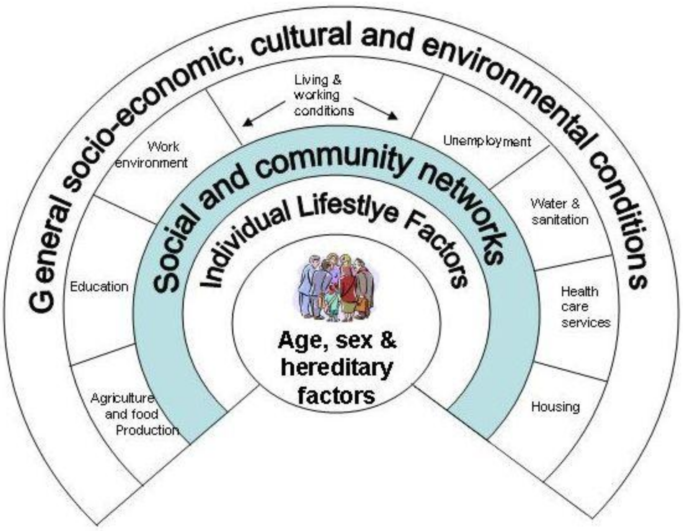


Figure 2.3. A health map for urban planners

Assessment of QOL and its effects is on human behavior is getting important in the frame of social sciences while it finds place as theoretical and empirical researches in economics. Investigating of QOUL is also defined as important in terms of effects on human behaviors and their life satisfaction, happiness(Ibrahim & Chung, 2003; Pacione, 1990). QOL and QOUL have implications in researches as:

- They are kinds of indicators showing the needs of public action.
- They are control systems of assessing the planning activities and getting feedback in effectiveness of urban policies.
- They encourage the site selections of residential locations.
- They have implications for detecting of regional migration, regional economic growth, and environmental sustainability.

Some researches base some features of migration patterns and urban growth arise on also QOL differences between places that is lead to reflect employment opportunities. QOL differences between places are categorized in objective characteristics of neighborhoods and the subjective evaluations of people and also patterns of intra-urban movements are related to these differences in some respects(Marans & Stimson, 2011; Pacione, 2012).

In a particular place, in particular scale and settings, in order to measure QOL, some measurement conditions are required in that place using sets of indicators. Besides, it is required to monitor changes of QOL conditions over time in order to determine how the conditions have changed. Further, it is important to determine whether the conditions have improved or deteriorated if there is a change. And these efforts continue with evaluating the condition improvement interventions of public and private sectors. Within the context of subjective judgments of people it is known that they all have different evaluations about the things which affect their urban environments. To make an adequate investigation of QOL, it is required to develop model frameworks and to collect data to manage the frameworks within a particular place context (Maantay & Mclafferty, 2011) andas implemented by (Andelman et al., 1998), evaluation models have been defined through two approaches:

- The objective approach which is based on the analysis and reports of secondary data and the data is mostly available at spatial scales at different geographies aggregated from governmental offices including census. And this approach is defined as related with social indicators research.

- The subjective approach which is based on individual level data using social survey to assess peoples' behaviors and evaluations about aspects of QOL in general and QOUL in particular.

A set of objective and subjective indicators are identified as in the table below that can be lead to evaluate QOL in a city or in a neighborhood within a city. Addition to the objective and subjective indicators, behavioral indicators is also identified to the approaches (Andelman et al., 1998). Table 2.2 show the objective, subjective and behavioral indivcator examples of QOL indicatos discussed by (Maantay & Mclafferty, 2011).

Table 2.2. Examples of QOL indicators

Objective Indicators	**Subjective Indicators**	**Behavioral Indicators**
Employment rates	Housing and neighborhood satisfaction	Public transit use
Educational attainment	Desire to move	Participation in sports
Per capita income	Perceptions of crime	Amount of walking and bicycling
Crime statistics	Perceptions of school quality	Visit to cultural amenities and events
Domestic violence	Perceptions of health care services	Visit to parks
Death rates	Feelings about neighbors	Visit to health cliniques and doctors
Incidence of choronic diease	Feelings about rubbish collection	Amount of neighboring
Air quality	Feelings about congestion and crowding	Participation in voluntary organizations
Residential density	Feelings about government	Participation in local decison-making organizations
Housing vacancy rates	Satisfaction with health	Residential mobility
Amount of parkland	Satisfaction with family, friends, job etc.	
Number of public transit riders	Life satisfaction, overall hapiness	
Distance to transit stop		
Availability of grocery/food stores		
Vehicle kilometers/miles traveled		

QOL indicators has been classified into four groups by TÜBA (Tekeli, Güler, Vaizoğlu, Algan, & Dündar, 2003) and listed as below:

a. The community-level objective indicator of the quality of life: (environmental quality, human resources, health conditions, education level, economical indicators, social integration, the nature of the political system, the quality of the settlement)
b. The community-level subjective indicator of the quality of life (a risk-free living environment, high-quality human resources, safe healthy living, perception of economic opportunities, alienation, a sense of exclusion, the degree of openness to the participation of communities in decisions and make sense of pleasant living)
c. The individual-level objective indicator of the quality of life (ways of relating to the natural environment, health-related quality of life index, educational level, the level of income, artistic and scientific achievement, position of social differentiation, level to participate in the political process, the degree of spare time being, the residence of the quality)
d. The individual-level subjective indicator of the quality of life (a sense of living in harmony with nature, well-being, educational success, enough-income, artistic and scientific achievement, the sense of being subject, realizing non-business activities and social intercourse satisfaction)

The possible link between objective dimensions and subjective evaluations of the urban environment is described as challenging for researches by its nature. In order to inform planning agencies and policy interventions about improvement of QOL, it is essential to assess the linkages between indicators.

It is indicated that the quality of life experience finds place in the context of the social and cultural aspects of the subject. Those researches also propose that the objective dimensions of the society such as crime rates, poverty and pollution affect peoples' evaluations of their lives.

QOL is also described as multi-faceted concept and interdisciplinary field of study(van Kamp et al., 2003). And it is indicated that the notions of QOL, satisfaction, happiness and well-being are difficult to distinguish between. QOL concept is studied by wide range of researches from academic disciplines as well as interest of politicians, policy makers, planners and environmental professionals in.

QOL studies are criticized of examining individuals' attributes such as their age, employment, health and interpersonal relationship instead of their living places. The places might be examined at various scales, from a residential unit to a neighborhood, to a city or a broader region. It is certainly emphasized that examining the relationships between characteristics of urban environments and the perceived QOL of the people.

In the studies of QOL, it is shown that the context of place is important and also QOUL studies are required to understand QOL and its measurement issue deeply. There are works exploring the relationship between objective and subjective dimensions insisting that the quality of a place depends and differs on subjective evaluations of individuals at various scales. It is also proposed that those evaluations reflect individual's perceptions and assessments of all attributes (Maantay & Mclafferty, 2011).

Monitoring objective indicators provide improvement or deterioration information of QOUL, while subjective data ensure individual and also community level evaluations, perceptions and behaviors with the urban life. However, those indicators are also indicated as limited as much as they are useful. It is indicated because; indicators by themselves cannot represent the different features of urban life and environments. The approaches may not be aware of the unique contribution of any one factor to the level of whole satisfaction. Thus, it is emphasized to develop a model to analyze the relationships of indicators and to test hypotheses about the relationships. The models are determined as statistical techniques for testing and estimating the relationships among variables and causal relations using a combination of statistical data and qualitative causal assumptions. However, it is seen that it is difficult to model complex relationship between the dimensions of urban environments and QOUL domains unless it is examined within a theoretical framework.

Beside to the complex structure, urbanism is described as an also structure that consisting of many dimensions such as demographic characteristics, economic stress, social stress and environmental stress.

Although there are the views about the complexity of the issue, there are works that had been done to assess the relationship.It has been declared a model in order to assess the satisfaction of residential environments and also the model is varied (A. Campbell, Converse, Rodgers, & Marans, 1976). The frame of the model consists of the demographic, social, economic, environmental and domain satisfaction relationships. The principles of that the model depends on are identified as the subjective experiences of people from their surrounding environment, objective dimensions of environment, the different level of life domains contributing to the overall QOL(A. Campbell et al., 1976). Figure 2.4 represents the domains of (human) livability and (environmental) quality of life defined (van Kamp et al., 2003). Besides, Figure 2.5 shows the relationship between domain satisfaction and life satisfaction (Maantay & Mclafferty, 2011).

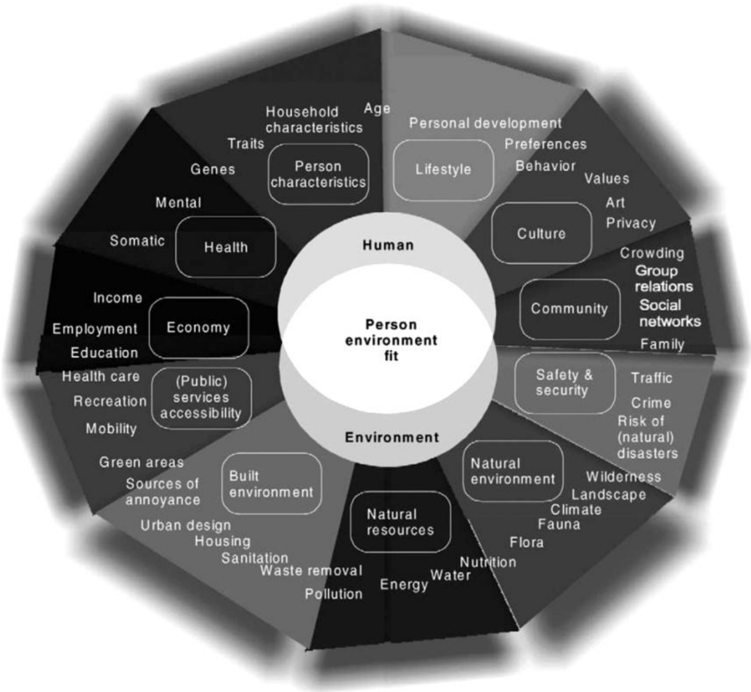


Figure 2.4. Domains of (human) livability and (environmental) quality-of-life

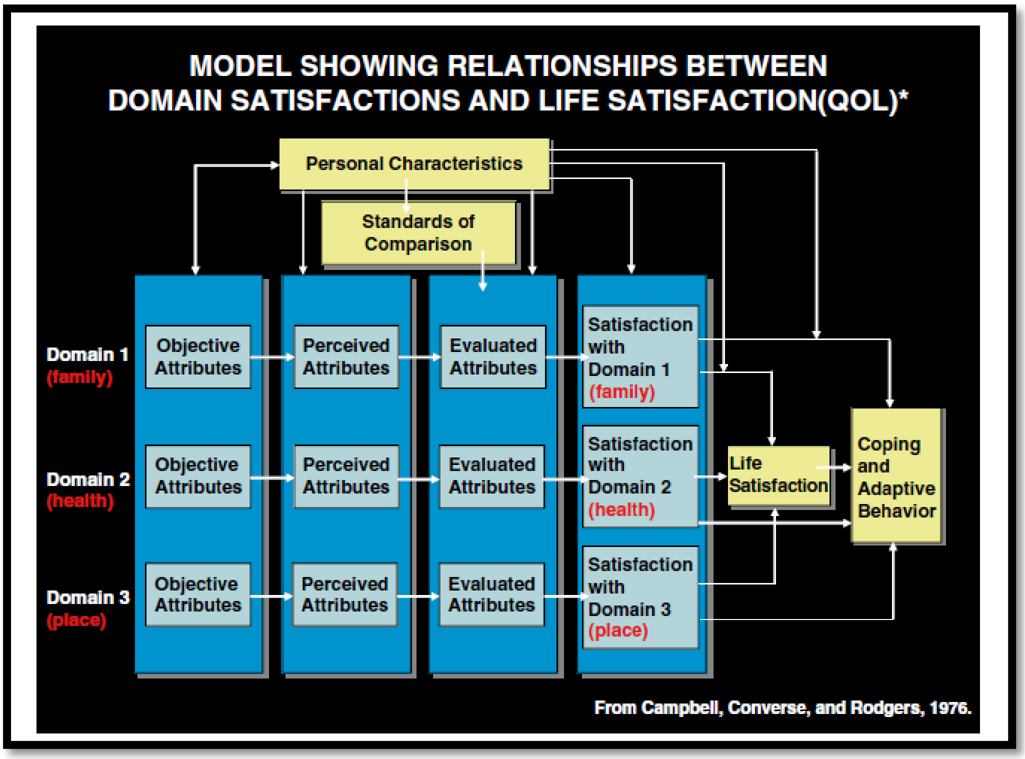


Figure 2.5. The relationship between domain satisfactions and life satisfaction

All attributes of the environment and all characteristics of people are relevant domains in the person–environment relationship. an overview of all domains that were encountered in the literature is given in the fig. of domains of livability and environmental quality-of-life (van Kamp et al., 2003).

The model that proposed defended that the level of satisfaction depends and it can be changeable according to the level of life domains(A. Campbell et al., 1976):

- • 'Satisfaction with housing'
- • 'Satisfaction with neighborhood'
- • 'Satisfaction with the wider community (or broader region).'

The model was defined as a bottom-up model framework which corresponds to urban characteristics contributing to satisfaction in a specific domain which, may be turns into overall satisfaction of life. The model shows economic, social and environmental relations between the characteristics of urban living contributing to satisfaction with different living domains, and those relations are mostly between variables at the same level of analysis (A. Campbell et al., 1976).

2.3.1. Well-Being, Satisfaction and Happiness Concepts

There are also many terms related to the concept QOL in the literature. Those terms are well-being, happiness and satisfaction. These are generally used in order to investigate the features of QOL and life experiences. The first attempts of the QOL studies, QOL experience has been conceptualized as individual well-being. The main aim was on measuring the 'global evaluations of life' satisfaction rather than on 'actual conditions of life'. Besides to these, it is considered that context and person characteristics are also important to understand QOL. With context it is expected to understand the actual conditions of life or 'objective attributes. Objective attributes are also mentioned by(A. Campbell, Converse, & Rodgers, 1976), concerning domain satisfaction, that they influence the peoples' perceptions and the attributes of each minor domain.

2.4. Connections between Health and Urban Planning – Health Concept

The WHO already adopted a broad definition in 1946, stating that health is "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity". Also in researches, the concept of health has expanded beyond a mere absence of illness and objective indicators of health, to address well-being and quality of life.

In Europe, healthy city planning principles and practices are considered as the main theme by the WHO Healthy City Project fifth stage (Başaran, 2007). The goal of the project is to show the close relationship between urban planning principles and healthy city approaches and thereby to make the urban planning to refocus on the health and quality of life.Urban planning processes is supposed to use this approach by combining the equity, intersectoral collaboration, sustainability, public participation and intersectoral action and its principles of solidarity.

Health is defining as not just absence of disease status; it is physical, mental and social well-being state. The highest attainable standard of health is the fundamental right of every human being without distinction between race, religion, political belief and social and economic conditions (Başaran, 2007; Santos, Silva, Ramos, & Torres, 2012).

Concept of health defined by theWHO is opposed to the traditional beliefs that health policies are just the matter of professionals interested in health. Contrary to the popular belief, health should be one of the main objectives of many profession and disciplines, and in particular urban planning has a key role of designing healthy environment.

Health, both at local and global level, is directly connected to the environment. A healthy life style is defined as the issue of consisting house quality, work, transport, food, soil, water and air quality, sanitation, solid waste, climate stability (Başaran, 2007; Santos et al., 2012). The quality of urban life is a basic structure for human health. In cities of today, the common problems are associated with the poverty, pollution, unemployment, inequality in access to goods and services, lack of social cohesion, low quality housing and environment. The health of citizens can be affected by living and working conditions, physical and socio-economic environment, the quality and accessibility of care services(Başaran, 2007).

The quality of urban life is a fundamental base for human health (Santos et al., 2012; Tsouros, 1995). Rural to urban migration has effects on physical structure of the city as much as on government service requests of citizens. Authorities lead the priority tasks according to the financial possibilities such as basic urban infrastructure services, works on environmental and consumer protection, special education for disabled people in need of care, and housing for senior citizens. Life within the social and physical environments is major determinants of health. From this perspective, cities have the special potential to ensure and to improve the conditions of health. One of the most important tasks of local governments is to establish public health policies taking into consideration all of the urban life conditions (Başaran, 2007; Santos et al., 2012).

"Healthy city" concept is defining as a frame consisting of many different disciplines. It refers different meanings to every country, every city, every culture, even every citizens living in the same city. This concept has emerged within the Healthy Cities Project and aims to make local governments and city planners to refocus on people's well-being and health, to replace health objectives on the center of the decision-making process (Başaran, 2007; Santos et al., 2012). The concept of healthy city definitions differentiate based on different points of views and different study areas, as to renew the city's major values and to create new places, to create qualified physical environment at residential areas and at green areas, to build and develop social cohesion, to ensure accessibility to health services and to ensure to live safely and freely in an urban context. Basis of this explanation, the concept of a healthy city is a concept that incorporates many different disciplines such as sociology, urban geography, urban planning, ecology, economics and politics (Tsouros, 1995). In brief, a healthy city contains all of the elements of livable cities. It should be understood that healthy city is not the city that achieves a certain level of health; it is the city that initiates the process of required structural changes towards a healthy and livable city.

The WHO defines the features that a healthy city should have as a sustainable ecosystem, quality and safe physical environments, a society with provided basic needs and participated in decisions about the future of the city, innovative economy, optimum access to the goods and services, an environment that cultural and historical assets are protected in, high level statue of health, low level incidence of a disease(Santos et al., 2012). The WHO European Healthy Cities Network aims to attract attentions of sectors other than the health sector to include the health development plans across the cities and social issues related to health to their agenda. For this purpose, the WHO Regional Office for Europe has been working to achieve the implementation of "Health for All" within the "Healthy Cities Project" at the local level. Healthy Cities Project is developed to solve the problems of health and livability issues in cities in both developed and developing countries (Başaran, 2007; Santos et al., 2012).

In 1986, 11 cities was chosen in order to prove that new public health approaches based on the implication of "Health for All" principle will be successful. In 1991, the idea that Healthy Cities Project may be an approach for solving the problems in cities in both developed and developing countries has been dominated. It is aimed to take everyone's attention to the health issue to ensure the implication. In the beginnings of 1992 the National Healthy Cities Network reached a number composed of approximately 375 cities and the villages. In the same year, in Europe 200 cities and 500 cities around the world has been included to the "Healthy Cities Network". In 1977, as a first attempt, the role of national governments on the fulfillment of health services was pointed out with the World Health Meetings.In 1984, about the implication of ‘health for all’, 38 targets have been determined six of which are particularly important (Başaran, 2007):

1. Health inequalities within and between countries should be reduced.

2. Health development practices and the importance of preventive measures should be emphasized to achieve physical, mental and social well-being of a person.
3. Various sectors should cooperate in order to protect people from environmental hazards and help them to reach the basic condition of health.
4. Community participation is a must to achieve the goal of the "Health for All" project.
5. The health care system should make fundamental health services reachable for the people.
6. For health problems that transcend national boundaries international co-operation should be provided.

A long-term goal of Healthy Cities Project is to improve the people health in European cities. The project applies the WHO principles of in the 2000s, “Health for All” (Başaran, 2007). These principles are the ones which were highlighted at the Charter of the Ottawa Health Development and Local Level Environment and Health of European Charter. The main objective is to make the cities applying “Health for All" application locally. In this case, a specific plan of the city development and the provision of new organizational and definitional structures become essential.

The described frame includes five items (Başaran, 2007):

1. To encourage healthy society policy,
2. To create supportive environments
3. To strengthen community participation
4. To encourage to develop personal skills,
5. To re-guide health services.

In 1988, declaration of Adelaide healthy public policies as the main result of Healthy Cities Project had been considered in detail. Later in Rio de Janeiro, in 1992, a conference was organized by the United Nations Organization on "Environment and Development ". In the conference which serves as a turning point in terms of the world environmental movement, the five international documents also including Agenda 21 were signed (Başaran, 2007).

The first quarter of Healthy Cities Project were completed. The first period took place between 1987 and 1992, and it was ended by being included of 35 cities to the Healthy Cities network. The main theme of this period was shaping the structure that will make changes for a healthy city. The second period took place between 1993 and1997, and the main theme was healthy public policies and extensive health plans to the city. In the first period, including 13 cities participated in any network; the network was consisted of 39 cities. At this stage, with a strong emphasis on comprehensive city health planning and healthy public policy, more activities were addressed. In June 2000 Conference in Athens showed that second phase has ended and third era has begun. In this context, the cities of each project separately created national networks and continued making efforts to improve health of communities in line with the principles of the "Health for All". The fourth period of the project took place between 2003 and 2008. The fourth phase had more than 70 cities in the European Network and the main themes of this period were a healthy city plan and health impact assessment. As a complementary theme healthy aging was determined. There were nine duties expected from cities during the fourth quarter including (Santos et al., 2012):

1. Providing local support / maintenance,
2. The appointment of the coordinator and the steering group,
3. Establishment of partnerships to work on the main themes,
4. The city health development plan preparation / development,
5. preparation of the city health profile / updating,
6. Attending the meetings of the European Network of WHO,
7. Attending meetings of mayors,
8. Contributing to and participate in network activities,
9. Establishing monitoring and evaluation mechanisms, being ready to evaluation activities of the WHO.

At the present time, the European Network of Healthy Cities is in the fifth period that will last between 2009 and 2013. Almost 94 cities committed to fulfill the main goals and themes of this period. According to the declaration of the Zagreb Healthy Cities, cities have been expected to work on health protection and equity in local politics, to monitor all sectors related to health, welfare policies and actions. Fifth period is based on conclusions and advices from the Global Commission on Social Determinants of Health to implement the main goals. Cities are expected to define measures encouraging different sectors and society collaboration in health and equity and planning issues. The municipalities of the Network cities are encouraged to implement the goals (Santos et al., 2012).

The fifth phase has three main topics as environmental promoters of support and care, healthy lifestyle and healthy urban environments. During this phase, cities have opportunity to implement their policies by taking health as a central theme among sectors. The cities are also required to find resources, support and structure to fulfill Healthy City Project themes by the WHO.

The healthy approach in urban planning is more appropriate for planning activities within the frame of sustainable development, because the target of a healthy city is a healthy economy, a healthy environment and a healthy society. In the process of developing a healthy city, all related stakeholders (central and local governments, private sector, non-governmental organizations, and citizens) are expected to be in continuous collaboration. Healthy city approach takes into consideration social, environmental, economic and cultural issues and how these affects individuals, communities and populations lives. Healthy urban studies aim to protect the environment and human health, to control environmental pollution causing factors and to provide efficient service to the city. Solution oriented contribution, participation and sensitive attitude of all citizens will contribute to create a healthy city(Başaran, 2007; Santos et al., 2012).

2.4.1. Izmir Healthy Cities Project

Izmir Metropolitan Municipality applied to be a member of Turkish Healthy Cities Association on Jun 02, 2006 by Resolution of City Council in order to ensure that limited resources will be used properly, the good and services will be provided in accordance with the principle of equality and will aim to improve life quality, and the decision-makers in the city will be able to put the health topic on top of the agenda ("http://skpo.izmir.bel.tr/content.aspx?MID=30," 2013).

A protocol was signed between Office of Izmir Governor, Izmir Metropolitan Municipality, Ege University, Dokuz Eylul University, Izmir Institute of Technology, Izmir University of Economics and Yasar University on 2007 in order to provide collaboration with Healthy Cities Project Office by expert staff within a common platform and that reliable data could be figured out more easily by Izmir Greater Municipality, and therefore a project partnership was established. As per the protocol, all the project partners have appointed a coordinator as to advance the movement “Healthy Cities”.

An invitation letter inviting the state institutions and organizations to the platform was sent on Jun 2007 in order to establish a Healthy City Platform. At the end of the contact meetings with the representatives, working groups were generated with academicians, democratic mass organizations, non-governmental organizations, trade associations, and with the representatives of Municipality and Office of Governor. ("http://skpo.izmir.bel.tr/content.aspx?MID=30," 2013).

2.4.2. Determinants of Health

Inequalities in health are reflected in different situations in different countries, thus comparison can be made with measured situations. There are criteria that are used to measure and compare differences between communities scientifically. Indicators of determinants of health are defines as level of education, social security, safe drinking water usage rate, the percentage of the population with adequate sanitation conditions, the level of poverty, Gini coefficient, level of income, the Lorenz curve, Robin Hood index, unemployment rate, infant mortality rate, maternal mortality rate, the dead birth rate, life expectancy at birth, age-and sex-specific life expectancy(Irgil, 2010).

Irgil also categorized and grouped health determinant indicators under the major headings as(Irgil, 2010):

- In the context of individual (biological) scale - genetic, gender, age
- In the context of social scale -economic poverty, unemployment, working conditions, social exclusion
- In the context of physical environment -air quality, housing, water quality,
- In the context of life style - social environment, physical activity, obesity, smoking, alcohol, drugs, sexual preferences
- In the context of services accessibility - education, health, social services, transportation, leisure-time
- In the context of urban planning, health determinants is specified into 12 key principles for the city planners:
    1. Healthy Lifestyle
    2. Social Unity
    3. Housing Quality
    4. Job

5. Accessibility
6. Nutrition
7. Safety
8. Equality
9. Air Quality
10. Water And Sewage Network
11. Soil And Solid Waste
12. Global Climate

Conducted studies show in general, inequalities in health are emerging according to socioeconomic status, education level, geographic location, gender, ethnic groups and age groups. Also the disadvantaged groups of nomads, the homeless, refugees etc. are the ones that health inequalities are seen as unavoidable(Irgil, 2010).

2.5. The Role of GIS in Environmental Health Research

GIS is used as a common tool to be equipped with an electronic environment in which linking the exposure model with the demographic, migration and health data of the exposed population. The integration of the model in a GIS together with individual data and information from routine health statistics proved its usefulness in demarking the exposed population (Poulstrup & Hansen, 2004).

GIS technology is being used in social research including QOUL studies. GIS has been applied in assessment of accessibility to opportunities such as education, employment, goods and services, recreation and health care services in urban environments. Related researches have examined the relationship between urban life and health levels. Besides GIS makes it available to combine survey based data on subjective QOUL at the individual level with spatial objective data of urban environment (Marans & Stimson, 2011).

The GIS technology has widely been used for years to explore spatial distribution of diseases and particularly different cancer types to investigate the cause and effect relationships from different perspectives. GIS applications in literature, are categorized and summarized as environmental hazard surveillance, exposure assessment and health outcomes surveillance.

Environmental hazards include biological factors, drinking water, and disease carrying insect vectors; chemical factors or chemicals from industrial sites; and physical factors related to physical urban systems. Environmental health studies are related to the effects of these environmental factors on human health and the effective health policies to handle the effects. Basic issues in environmental health are defined as monitoring the uneven distribution of hazards and thereby comprehending the exposure of people to environmental hazards and assessing the effects on human well-being (Maantay & Mclafferty, 2011).

Main aim is defined as to address the health inequalities across places and communities and to make apparent the health implications of global and local transformations within the economic, demographic and environmental scales.

Early GIS applications in environmental health issue are considered as analysis of spatial disease clustering of childhood leukemia living near nuclear facilities(Openshaw, Charlton, Craft, & Birch, 1988). GIS has been used to be characterized populations living near high-voltage transmission lines(Wartenberg, Greenberg, & Lathrop, 1993). In 1990s, GIS also started to being used in vector-borne disease studies for determining the associations between environmental features and disease densities. GIS applications have spread among the researches of environmental health assessments and public health planning since that time (Maantay & Mclafferty, 2011).

In Turkey, despite the past and ongoing researchand studies on spatial distribution of cancer andother diseases from the point of epidemiology, thenumber of research is quite limited compared tostudies in developed countries. The relationship between theincidence rates, mortality and environmental riskfactors in Trabzon province was explored by using cancer-registrycenter data(Yomralioglu, Colak, & Aydinoglu, 2009). It has been investigated the correlationbetween different cancer types and geographicalfactors. It has been pointedout that necessity of GIS in health care system bycomparing studies in the world and Turkey and alsoquestioned how GIS could be utilized moreeffectively(Kalelioglu et al., 2007).

2.5.1. Hazard Surveillance

GIS has been used as a tool to monitor the spatial distribution of environmental hazards whether they are clustered or randomly distributed and to manage the database about hazard locations. Samples that are collected at different points are entered to GIS spatial database and then they are mapped to display geographic differences. It has been pointed that spatial interpolation methods such as inverse distance weighting and kriging are used to estimate concentrations of contaminants at locations where no measurements are available(Zhen, McDermott, Lawson, & Aelion, 2009).

The result maps show the high-density environmental hazard areas with a constant surface. It is important to understand how environmental hazards move and change through environmental factors such as air, water, soil and wind in space and in a specific time, how human interactions change from place to place. Therefore, these methods can also be enlarged to estimate all these mentioned factors. It has been confirmed that hydrologic models of surface and groundwater systems and network models of municipal water supply to trace the waterborne flows of pollutants(Root & Emch, 2010). Many environmental indicators are visualized by using GIS methods such as natural and built environmental features. Built environments include a series of features that can be either hazardous or beneficial for human health.

2.5.2. Exposure Surveillance

Exposure surveillance examines the conditions that people are exposed to environmental hazards and the processes of exposure itself and its results in terms of health effect(Maantay & Mclafferty, 2011). GIS implementations are seen as focusing on the environmental processes that influence human contact with hazardous substances. The required data in exposure assessment, which are defined as population and environmental hazard data, are seen well linked to each other via GIS tools (Molitor et al., 2007). GIS applications such as overlay and spatial buffering have been largely used to estimate populations exposed to environmental hazards. Overlay links variables based on geographic location on map. In spatial buffering, GIS identifies the zone that falls within a specific distance of a point, poly-line or area.

2.5.3. Outcomes Surveillance

Outcomes surveillance monitors the health impacts of environmental exposures. GIS is used to create maps of health outcomes and to analyze associations between outcome data and environmental hazards and exposures by researchers. Analyzing spatial clusters or "hotspots" of health outcomes is significant in case they are the presence of an environmental hazard that is responsible for the spatial clustering of any diseases.

The relationship between health outcomes and environmental hazards and exposure are required to be linked data on hazards exposures and outcomes via GIS. There are analyses reveal that important information about cause of the diseases (etiology) by indicating potential environmental alerts.

The assessment of hazards, exposures and health outcomes; geospatial techniques have an important role in planning public health interventions to reduce environmental health concerns(Maantay & Mclafferty, 2011). These interventions are defined as environmental modifications aimed in that they reduce disease transmission and exposure to hazards; medical strategies including vaccination and treatment; mobility strategies to alter human activity patterns and interactions; and behavioral strategies that focus on knowledge, education and experiences.

The connections between environmental hazards, exposures and health outcomes are fundamentally spatial, depending on the interactions between people and hazards through space and time. The data management, geo-monitoring and spatial analysis applications of GIS is valuable tools for environmental health assessment (Maantay & Mclafferty, 2011).

The scientists emphasized the importance of using spatially referenced health data to analyze the spatial distribution(Cockings & Dunn, 2003; Goldberg & Wilson, 2008). All studies in this research area require a detailed and accurate data, advanced spatial statistics. At this point advances in GIS offers powerful analytical tools to investigate spatial distribution of cancer.Clustering method is used to examine where specific cancer types are more intense(Amin & Bohnert, 2010; Goodman & Hudson, 2010; Wang, 2004).Wang (Wang, 2004) showed the effectiveness of GIS technology to calculate spatial statistics to explore the incidence rates and mortality of cervical cancer as well as Pap Smear test results in specific regions of New Brunswick, Canada.

Different analysis were performed in order to investigate the effects of environmental factors(Cornelis & Schoeters, 2008; Hwang & Kwon, 2006; Molitor et al., 2007). The common purpose of these studies is how environmental, geographical factors and certain land-use types affect the incidence rates of specific cancer types. Some studies were conducted researches based on time-series data(McKelvey, Brody, Aschengrau, & Swartz, 2004). The results of these studies give insights of how environmental or other factors could affect the spatial distribution of cancer over time.

Identifying trends in cancer data is an essential aspect when assessing the surveillance of a disease, and important factors associated with the disease. Trends in cancer data can reveal places where there is a higher than expected incidence of a cancer. Areas with higher than expected incidences of a cancer are also called cancer clusters. A cancer cluster is defined as a greater than expected number of cancer cases that occurs within a group of people, in a geographic area, or over a period of time (Guajardo, 2008; Nyberg et al., 2000).When evaluating the possible existence of a cancer cluster in an area, it is important to notice a few key facts:

> "*1) cancer is a common disease, affecting about one in four people in their lifetime; 2) the term cancer refers not to a single disease, but instead to a group of related yet different diseases; 3) a cancer cluster may be due to chance alone, like the clustering of balls on a pool table; and 4) an apparent cancer cluster is more likely to be genuine if the cases consist of one type of cancer, a rare type of cancer, or a type of cancer that is not usually found in an age group"(http://www.cdc.gov/hicpac/2007ip/2007isolationprecautions.html, 2007).*

2.6. Cancer Statistics in The World – Turkey and Izmir

This section is going to be examined as three parts: Cancer in the World, Cancer in Turkey and Cancer in Izmir. It is aimed to be shown that the lung cancer is the most widely cancer type in the World.

2.6.1. Cancer in the World

Cancer is a leading cause of disease in the World. An estimated 12.7 million new cancer cases occurred in 2008. Lung, female breast, colorectal and stomach cancers accounted for 40% of all cases diagnosed worldwide. In men, lung cancer was the most common cancer (16,5% of all new cases in men). Breast cancer was by far the most common cancer diagnosed in women (23% of all new cases in women)seen in Figure 2.6(http://www.cancer.gov/, 2011).

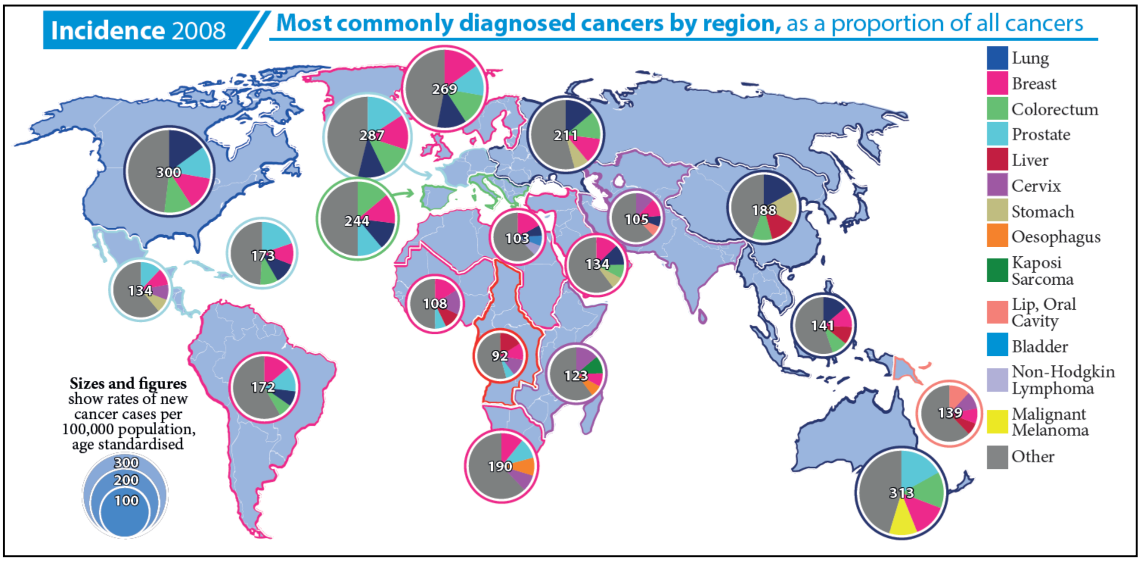


Figure 2.6. Most commonly diagnosed cancers in the World

2.6.2. Cancer in Turkey

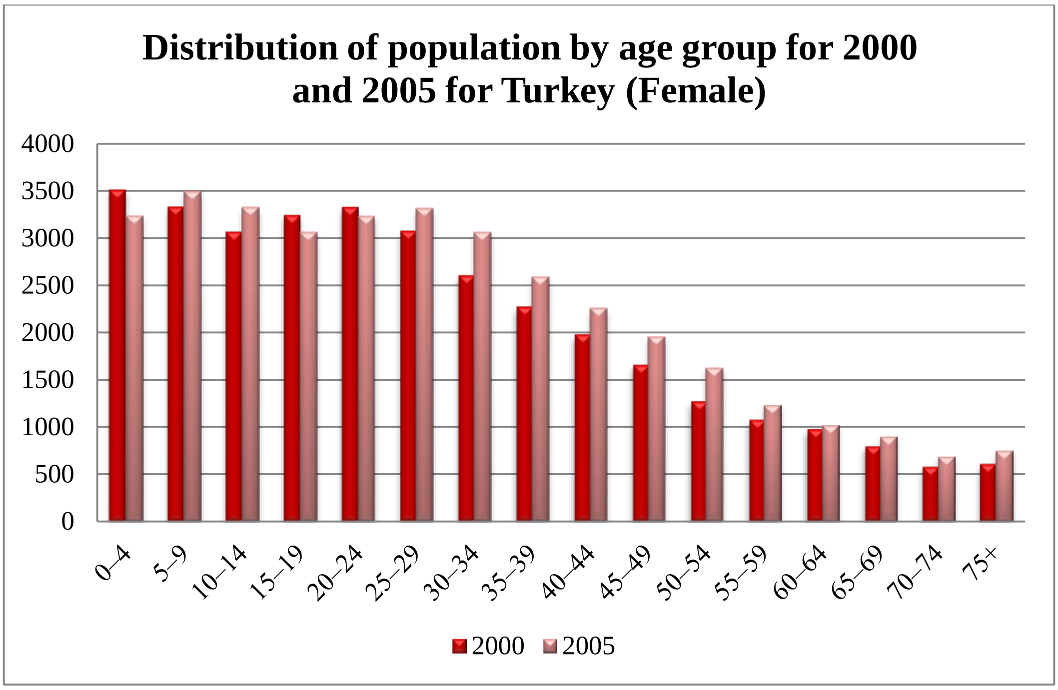
According to the WHO data estimations, the number of cancer-related deaths increasedfrom 6 million to 7.6 million between the years 2000 and 2005. Additionally, it was 7.9 millions in 2007, revealing a 32% rise in the magnitudeof cancer-related deaths between 2000 and 2007(Yilmaz et al., 2010).

It is examined that gradually higher proportion of thecancer-related deaths occurs in developing countries. In 2007,72% of 7.9 million deaths took place in developing countries(http://www.wcrf.org, 2013). The dissimilarity oftheir age-dependent demographic structure is one of the most prominentattributes of developing countries. In parallel withpopulation growth, the reversal of population pyramid andthe rapid increase of the population above 65 lead toproblems.Considering the distribution of population byage groups in Turkey it can be noticed that in 2005, 22% of the populationwas above 45. Population Database basedon 2000 Census and 2008 Address Based Population Database(http://www.turkstat.gov.tr, 2009)and it is estimated that this ratio willrise to 32% in 2030(Hoşgör, 2006).

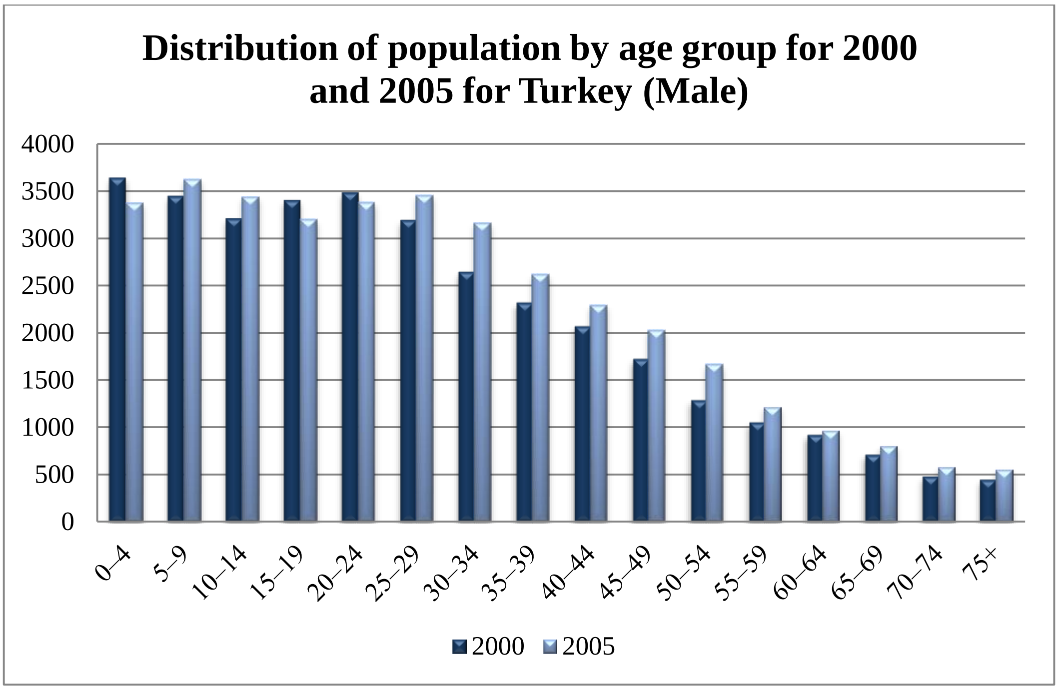
Turkey will havean older demographic structure especially displaying anincrease in the ratio of the population above 45 shown in Table 2.3 (Yilmaz et al., 2010). This comes forward as a situation that Turkey has totake into consideration cancer control programs in the followingdecades in addition to other significant risk factorsaffecting cancer incidences. Graphs 2.1, 2.2 and 2.3 show the graphical presentation of distribution of population by age group for 2000 and 2005 in Turkey.

Table 2.3: Distribution of population by age group for 2000 and 2005 for Turkey

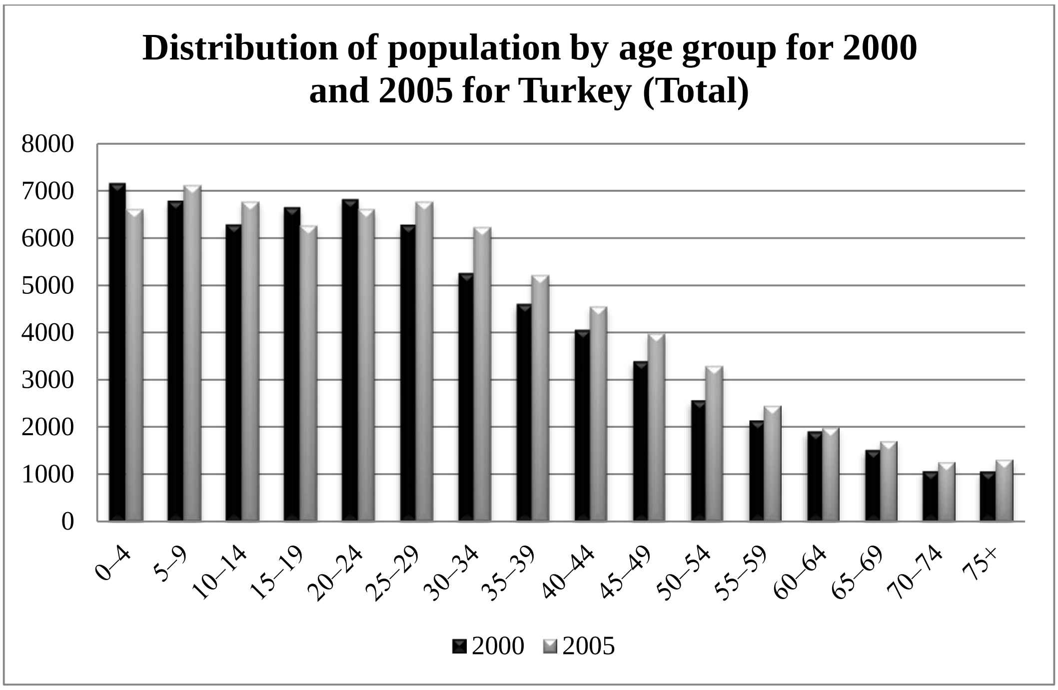
Age group (thousand)	**2000**			**2005**		
	Female	**Male**	**Total**	**Female**	**Male**	**Total**
0–4	3508	3644	7152	3236	3375	6611
5–9	3329	3451	6780	3496	3627	7123
10–14	3064	3212	6276	3323	3442	6765
15–19	3240	3405	6645	3058	3199	6257
20–24	3326	3485	6811	3231	3382	6613
25–29	3076	3194	6270	3313	3457	6770
30–34	2604	2647	5251	3061	3167	6228
35–39	2276	2321	4597	2588	2622	5210
40–44	1981	2069	4050	2255	2290	4545
45–49	1658	1724	3382	1954	2026	3980
50–54	1271	1287	2558	1624	1664	3288
55–59	1075	1053	2128	1231	1213	2444
60–64	977	921	1898	1021	960	1981
65–69	795	712	1507	896	800	1696
70–74	578	480	1058	683	574	1257
75+	608	448	1056	746	552	1298
Total	**33 367**	**34 053**	**67 420**	**35 716**	**36 349**	**72 065**



Graph 2.1. Distribution of population by age group (2000-2005) in Turkey - female



Graph 2.2. Distribution of population by age group (2000-2005) in Turkey – male

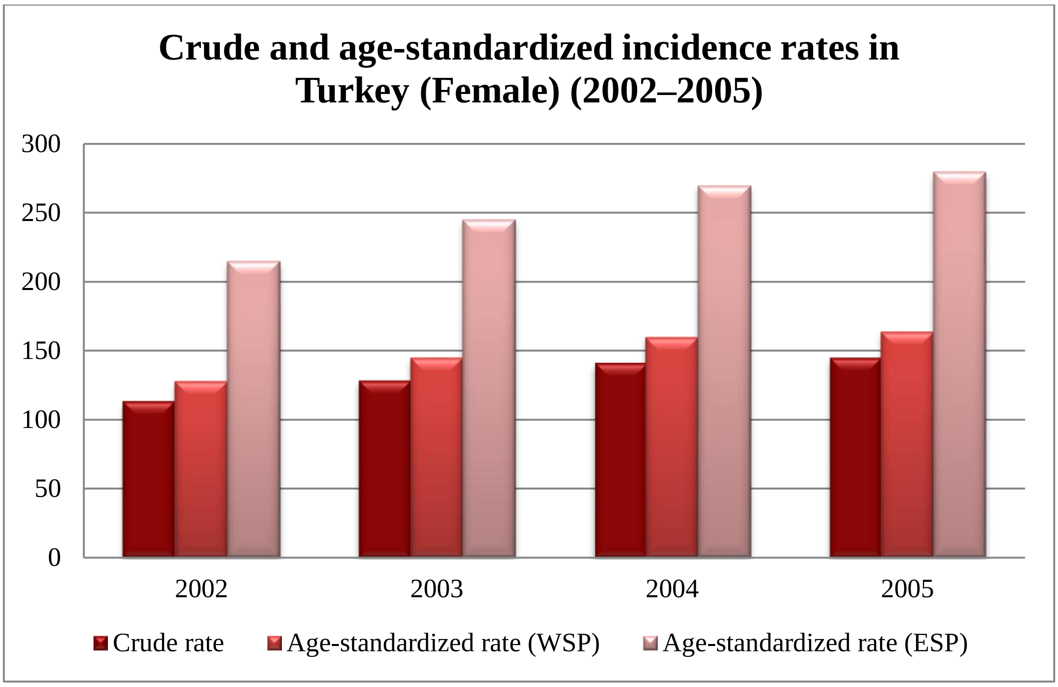


Graph 2.3. Distribution of population by age group (2000-2005) in Turkey - total

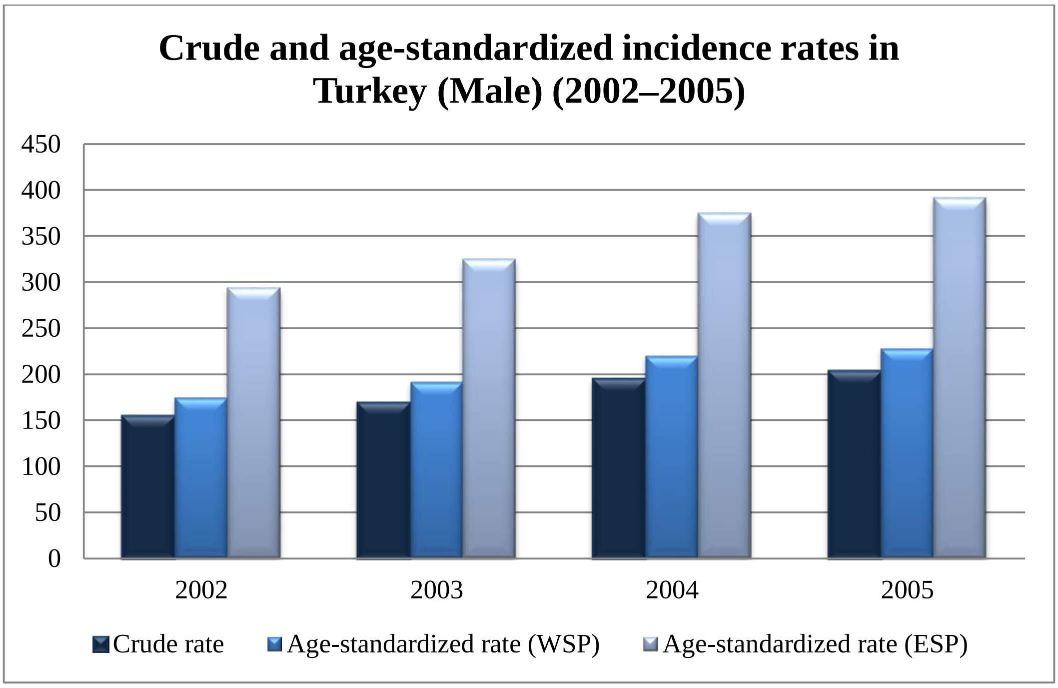
Table 2.4 includes the crude and age-standardized incidence rates in Turkey (2002–2005)(Yilmaz et al., 2010). WSP means World Standard Population and ESP means Europe Standard Population. Additionally, Graphs 2.4, 2.5 and 2.6 show the graphics of these rates. It is clearly observed that, Turkey has an increase rate in ESP.

Table 2.4.Crude and age-standardized incidence rates in Turkey (per hundred thousand) (2002–2005)

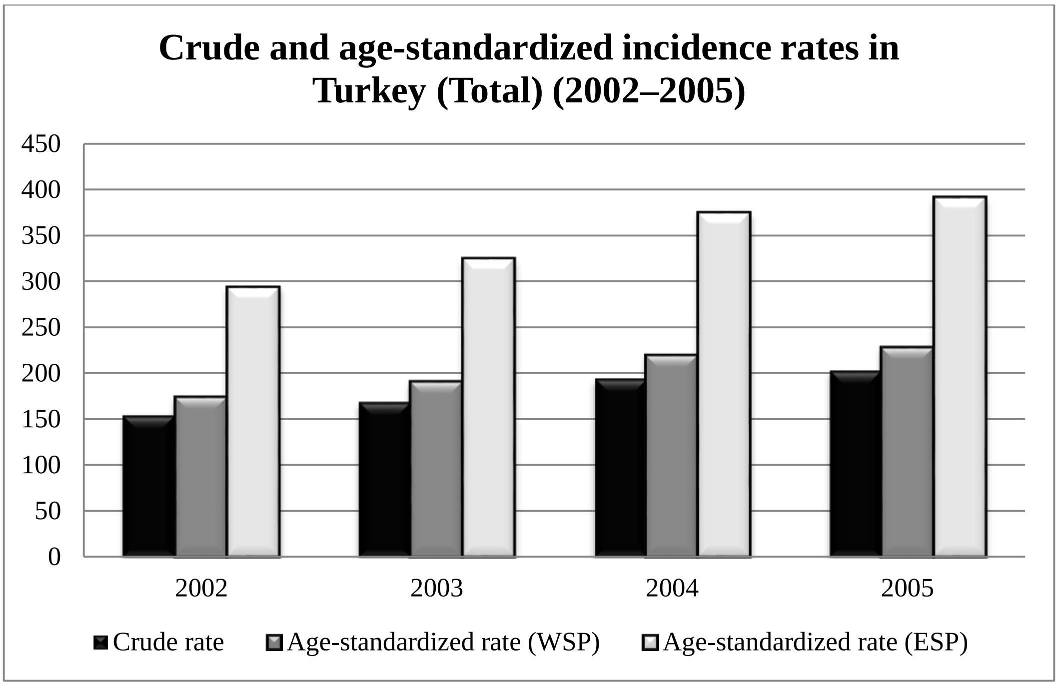
		2002	2003	2004	2005
Crude rate	Male	154,15	168,69	194,25	202,74
	Female	113,03	127,92	140,75	144,54
	Total	133,78	148,48	167,72	173,85
Age-standardized rate (WSP)	Male	174,47	191,16	219,64	227,98
	Female	127,68	144,78	159,35	163,53
	Total	151,8	168,72	190,38	196,76
Age-standardized rate (ESP)	Male	293,89	325,02	374,81	391,55
	Female	214,71	244,92	269,5	279,4
	Total	260,1	291,32	329,41	343,18



Graph 2.4. Crude and age-standardized incidence rate in Turkey (female, 2002-2005)



Graph 2.5. Crude and age-standardized incidence rate in Turkey (male, 2002-2005)



Graph 2.6. Crude and age-standardized incidence rate in Turkey (total, 2002-2005)

The most frequently seen cancer types in Turkey between 1996 and 2000 were published by (Mohan & Eser, 2008). Table 2.5 shows the most frequently seen cancer types in Turkey for male and Table 2.6 shows the most frequently seen cancer types in Turkey for female. For 1996-2000 years trachea, bronchus, lung cancer is the most frequent cancer type for male in Turkey. According to Table 2.6 breast cancer is the most frequent cancer type for female in Turkey. On the other hand, the subject of this thesis, lung cancer, has the 5th rank for female.

Table 2.5. Cancers most frequently seen Turkey, male, 1996-2000

Location	Crude incidence (per 100.000)	Age Standardized Rate (WSP)	Number of Cases
Trachea, bronchus, lung	37,3	47,7	12862
Stomach	9,6	12,2	3320
Urinary bladder	8,6	11	2952
Colon and rectum	7,4	9,1	2545
Larynx	6,4	8	2206
Prostate	6,1	8	2099

Table 2.6. Cancers most frequently seen Turkey, female, 1996-2000

Location	Crude incidence (per 100.000)	Age Standardized Rate (WSP)	Number of Cases
Breast	19,9	22	6729
Colon and rectum	7,6	8,5	2571
Stomach	5,7	6,4	1915
Ovary	4,8	5,4	1628
Trachea, bronchus, lung	4,6	5,3	1572
Leukemia	4,4	4,7	1505

In Figure 2.7, the map shows the most seen cancer types in Turkey. This map was scanned an article published in “Medya Sağlık Dergisi” in Jan-Feb 2013, No:2 pages 22-23 by Assoc.Prof.Dr. Sultan ESER. According to the article lung cancer has the highest incidence rate in Izmir; urinary bladder cancer has the highest incidence rate in Edirne, Eskisehir and Erzurum. Additionally, prostate cancer has the highest incidence rate in Antalya and Samsun, throat cancer has the highest incidence rate in Bursa, and finally, thyroid cancer has the highest incidence rate in Trabzon.

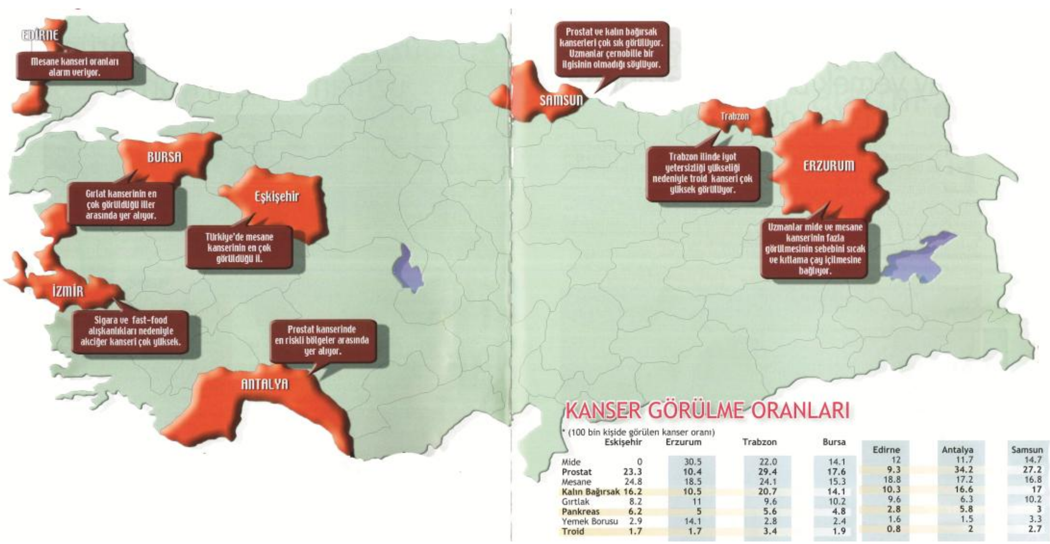


Figure 2.7. Cancer map of Turkey

2.6.3. Cancer in Izmir

It has been stated that the most frequently seen cancer types in Izmir between 1996 and 2000 are lung and breast cancers(Mohan & Eser, 2008). Table 2.7 shows the most frequently seen cancer types in Izmir for male and Table 2.8 shows the most frequently seen cancer types in Izmir for female. For 1996-2000 years trachea, bronchus, lung cancer is the most frequent cancer type for male in Izmir. According to Table 2.8 breast cancer is the most frequent cancer type for female in Izmir. On the other hand, lung cancer has the 5th rank for female in Izmir between 1996 and 2000.

ICRC calculated (Dr. Cankut YAKUT) that the most frequently seen cancer types in Izmir between 2000 and 2007. Table 2.9 shows the most frequently seen cancer type's incidence results in Izmir for male and Table 2.10 shows the most frequently seen cancer type's incidence results in Izmir for female. For 2000-2007 years trachea, bronchus, lung cancer is the most frequent cancer type for male in Izmir. According to Table 2.10 breast cancer is the most frequent cancer type for female in Izmir. On the other hand, lung cancer has the 5th rank for female in Izmir between 2000 and 2007. Graphs 2.7 and 2.8 represent the graphics of Table 2.9 and 2.10. Table 2.11 shows total age-standardized (WSP) cancer incidence in Izmir.

Table 2.7. Cancers most frequently seen in Izmir, male, 1996-2000

Location	Crude incidence (per 100.000)	Age Standardized Rate (WSP)	Number of Cases
Trachea, bronchus, lung	64,4	71,4	5197
Urinary bladder	12,4	14,3	1003
Colon and rectum	10,9	12,1	880
Larynx	10	10,8	806
Stomach	9,1	9,9	734
Prostate	8,5	10,2	685

Table 2.8. Cancers most frequently seen in Izmir, female, 1996-2000

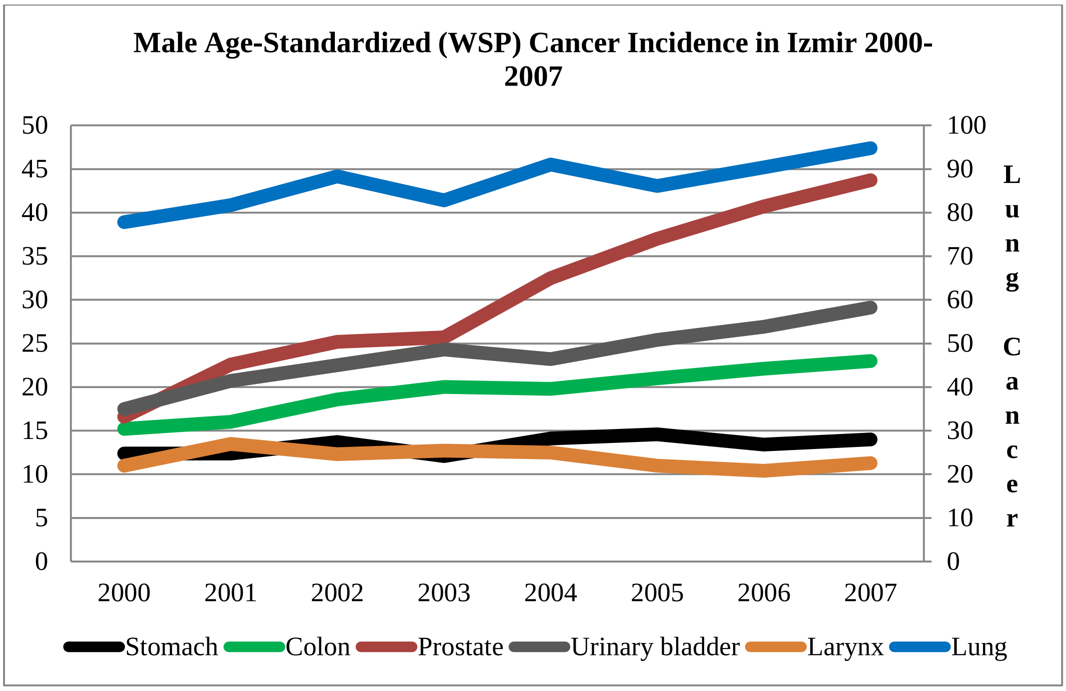
Location	Crude incidence (per 100.000)	Age Standardized Rate (WSP)	Number of Cases
Breast	31,6	31,1	2525
Colon and rectum	7,7	8	615
Corpus uteri	5,8	6	462
Cervix uteri	5,5	5,5	440
Lung	5,3	5,5	422
Ovary	4,9	4,9	388

Table 2.9.Male age-standardized (WSP) cancer incidence in Izmir, 2000-2007

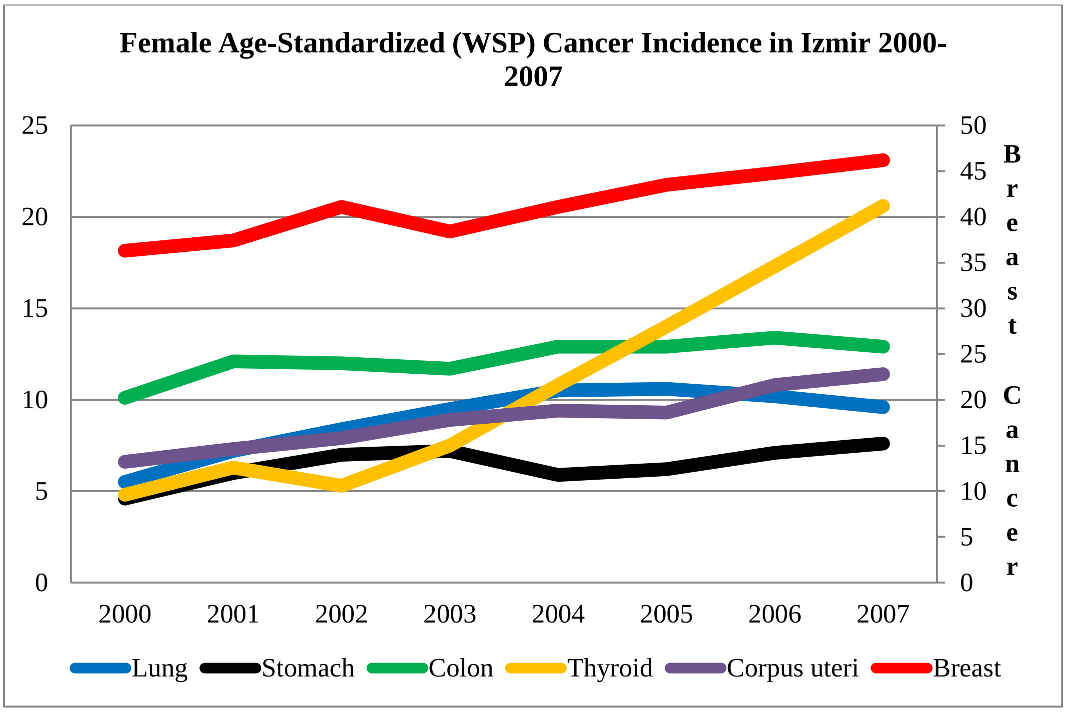
	2000	2001	2002	2003	2004	2005	2006	2007
Trachea, bronchus, lung	77,8	81,7	88,3	82,8	91	86,1	90,4	94,8
Prostate	16,6	22,6	25,2	25,7	32,5	37	40,7	43,7
Urinary bladder	17,5	20,7	22,5	24,3	23,2	25,4	26,9	29,1
Colon	15,2	16	18,6	20	19,8	21	22,1	23
Stomach	12,4	12,4	13,7	12,1	14,1	14,6	13,4	14
Larynx	11	13,5	12,3	12,7	12,5	11	10,4	11,3

Table 2.10.Female age-standardized (WSP) cancer incidence in Izmir, 2000-2007

	2000	2001	2002	2003	2004	2005	2006	2007
Breast	36,3	37,4	41,1	38,4	41,1	43,5	44,8	46,2
Thyroid	4,8	6,3	5,3	7,5	10,8	14	17,3	20,6
Colon	10,1	12,1	12	11,7	12,9	12,9	13,4	12,9
Corpus uteri	6,6	7,3	7,9	8,9	9,4	9,3	10,8	11,4
Lung	5,5	7,2	8,4	9,5	10,5	10,6	10,2	9,6
Stomach	4,6	6	7	7,2	5,9	6,2	7,1	7,6



Graph 2.7.Male age-standardized (WSP) cancer incidence in Izmir, 2000-2007



Graph 2.8. Female age-standardized (WSP) cancer incidence in Izmir, 2000-2007

Table 2.11.Total age-standardized (WSP) cancer incidence in Izmir, 2000-2007

	2000	2001	2002	2003	2004	2005	2006	2007
Male	214,5	241	256,6	258	273,2	280,2	289,4	307,5
Female	119,7	136,5	146,6	145,9	154,1	161,3	169,3	177,9

2.6.4. Cancer Registry

Cancer registry is defined as a registry process of specific cases of all cancers with clinical and pathological indicators. Registry centers are the place where records of patients diagnosed with cancer. There are different recording systems in the World. In Turkey, population based cancer registry system has been applied and aimed to be collected all cases of cancer information. This system has been based on the total number of new cases of cancer incidence value among those who reside in a defined geographical area, diagnosed during a calendar year. In order to be successful in this subject, it is necessary for decision making to be delimited geographical area and obtained true data. Incidence rate must include whole potential data source for the settlements (http://www.kanser.gov.tr, 2013).

There were 11 active cancer registry centers in Turkey in 2011. These provinces are Ankara, Izmir, Antalya, Edirne, Kocaeli, Samsun, Eskisehir, Trabzon, Gaziantep, Malatya and Bursa. The sample population rate of these centers is 27 %. With the system in Istanbul (both Asia and Europe), Adana and Mersin cancer registry centers (in Figure 2.8.), this rate was increased to 50 %(http://www.kanser.gov.tr, 2013).

Application areas of cancer registration are(http://www.ism.gov.tr, 2013):

1. Epidemiological Researches
   a. Descriptive Researches (determination of incidence rates, comparison of incidence and mortality rates of different groups, age and gender statistics, cancer statistics in international comparison with each other, geographic comparisons, establishment of geographic distribution atlases, implementation of ideas about etiology and potential risk factors, exposition of ethnic diversity, exposition of occupational diversity, socio-economic and exposition of religious diversity, comparing the differences in incidence over time)

b. Analytical Studies (causes of cancer research, monitoring of treatment results, comparative investigation of risk factors)

2. Health Services Planning and Follow-up (treatment and care centers planning, primary and secondary prevention studies and planning – evaluation, public education planning)

3. Patient Care Studies

4. Patient Tracking (Survival)

5. Screening Studies (Services carried out, evaluation of programs implemented)

Figure 2.8. Cancer Registry Centers in Turkey

2.6.4.1. Izmir Cancer Registry Center (ICRC)

This first cancer registry center in Turkey was established in Izmir in 1992. It was founded by the Ministry of Health and Ege University, in collaboration with the Turkish American Collaborative for Health Research and Programming, University of Massachusetts; now it is functioning as a department of the Izmir Provincial HealthDirectorate and is a member of the European Network of Cancer Registration(ENCR)(Fidaner, Eser, & Parkin, 2001).This registry became a member of WHO/International Agency for Research on Cancer's (IARC) International Association of Cancer Registries in 1995 and the ENCR in 1997 and was included within the framework of the Middle East Cancer Consortium (MECC) in 2004 (Stillman et al., 2012). This means that this registry was meeting international standards with high quality, publishable and representative data(Fidaner et al., 2001; M. A. Moore et al., 2010).

ICRC is a recording and research center that collects cancer data using an active method from the whole population appropriate to international standards since April 1992. All the hospitals of Izmir province concerned with cancer diagnosis and/or therapy are among the data resources of ICRC.

Objectives of ICRCare:

1. To collect information about cancer cases occurred in Izmir by using all kinds of data sources,
2. To calculate incidence rates of different cancers in Izmir,
3. By evaluating incidence rates lower or higher than expected, to make estimations to reveal new researches about specific cancer causes for the region,
4. To create a data-base for scientific researches,
5. To assemble reference evidences for projects to control cancer.

Izmir Cancer Registry is a center working as a subdivision of Provincial Health Directorate of Izmir; it collaborates with Cancer Division of Ministry of Health.Sultan Yalçın Eser, MD, PhD is responsible from the performances of activities, in behalf of Provincial Health Director.The administrative units of ICRC and their duties are:

A. Central office:

It coordinates the activities of the whole allied units, organizes and directs the educational programmes. Quality control of the all data collected, to enter the data to computer, control of duplications, evaluation of data, preparing the documents for presentations are among the duties of this office.

B. Cancer Registry Units:

Cancer registrars trained for this purpose and certified are working at "cancer registry units" located in the big hospitals of Izmir; most of them are graduated nurses. At those units, information about cancer cases are being collected by using a survey prepared for ICRC and according to needs and conditions of Turkey. That form is being changed occasionally in accordance with the experience and problems occurred.

Single cancer registrars are working at some of the hospitals without cancer registry units, and registrars are collecting data by at-site visits from the rest of the hospitals. About thirty cancer registrars are linked with ICRC. These are Hospitals with Cancer registry units, Hospital of Medical Faculty of Ege University, Ministry of Health (MoH) Izmir Ataturk Training Hospital, MoH Chest Diseases Training Hospital, Social Security Institution (SSI) Yenisehir Training Hospital, SSI Izmir Training Hospital, SSI Izmir Maternity Hospital

C. Advisory Committee

From each hospital with cancer registry units, a physician concerning with cancer cases is assigned as member of advisory committee. Members represent also different specialties. Committee joins quarterly and makes decisions for principal scientific rules about collecting and using data. Also committee directs the activities of ICRC.

The activities of ICRC are:

1. Organizing and participating to training courses for cancer registrars,
2. Organizing and performing in-service training programmes for cancer registrars
3. Participating to developing process of computer programme for cancer registries (CanReg),
4. Participating to scientific meetings.
5. Scientific relationship with international institutions, especially WHO/IARC (Lyon). ICRC is a member of ENCR.

There are several steps in collecting and evaluating data. They are:

1. Transferring data to central office. Main data resources are hospital cancer registry units, visits to hospitals without registry units, death certificates from "provincial health directorate", data from private pathology laboratories.
2. Control of accordance of data on each query ("internal control"), e.g. "male uterus cancer" or "female prostate cancer".
3. Adding data to database in computer by using CanReg.
4. Control of the forms for duplications ("external control")
5. Presenting data in tables.
6. Evaluating data according to population figures and calculating rates.

CHAPTER 3

STUDY AREA AND METHODOLOGY

In this chapter study area and methodology is described. Firstly, the study area and its characteristics are given, then, research data is explained as what it is, what the limitations are. Finally, the methodology of the thesis is given.

3.1. Study Area

Izmir Province, west of the Anatolian Peninsula, is located in the middle of the Aegean coasts. It is surrounded by Balikesir from North, Manisa from east and Aydin from south in Figure 3.1 (http://www.google.com/earth/index.html, 2013). City lands, 37"45' and 39"15' north latitude and 26"15' and 28"20' east longitude, is torn between. The distance of the north-south is approximately 200 km and the distance of the east-west is 180 km. The area of the city is 12.012 km^2(http://www.izmir.gov.tr/, 2012).

The study area is Izmir Province with its 28 districts corresponded to the years 1992-2007. In 1984, after the establishment of the Metropolitan Municipality, by the 3030 numbered law of the administration of metropolitan municipalities, its borders consist of 9 Izmir Metropolitan Municipality districts. However, in 2004 by the 5216 numbered law of the metropolitan municipality, Izmir Metropolitan Municipality borders have expanded including 19 districts (Table 3.1) (İBŞB, 2007b)

There are 9 districts within the boundary of metropolitan municipality, 28 districts within the boundary of province in 1992-2004, while there are 19 districts within the boundary of metropolitan municipality in 2005-2007. The following Figure 3.2 shows Izmir Metropolitan Municipality border before 2004 with dark blue, Izmir Metropolitan Municipality borders since 2004 with medium blue color. Besides these, as of 2009 Konak district has been divided as Konak and Karabaglar, also Karsiyaka district has been divided as Karsiyaka and Bayrakli, thus number of IBB districts have increased to 19. Cancer cases has been recorded in the districts of Konak and Karsiyaka until 2009, has been started being recorded in the districts of Konak, Karabaglar, Bayrakli and Karsiyaka. The cancer data will be shown within the border of districts before 2009.

Figure 3.1.Borders of Izmir Province

Table 3.1. Izmir Districts

Izmir Metropolitan Districts	Izmir Province Districts
Before 2004: Konak- Buca- Karsiyaka-Bornova- Narlidere-Balcova- Cigli-Guzelbahce- Gaziemir	**Before 2004:** Aliaga-Bergama-Dikili-Foca-Kinik-Menemen-Kemalpasa-Bayindir-Torbalı-Tire-Odemis-Kiraz-Beydag-Selcuk-Urla-Seferihisar-Cesme-Menderes-Karaburun
After 2004: Konak- Buca- Karsiyaka-Bornova- Narlidere-Balcova- Cigli-Guzelbahce- Gaziemir-Aliaga-Foca-Menemen-Kemalpasa-Bayındır-Torbali-Selcuk-Menderes-Seferihisar-Urla-Mordogan	**After 2004:** Bergama-Dikili-Kinik-Tire-Odemis-Kiraz-Beydag-Cesme-Karaburun

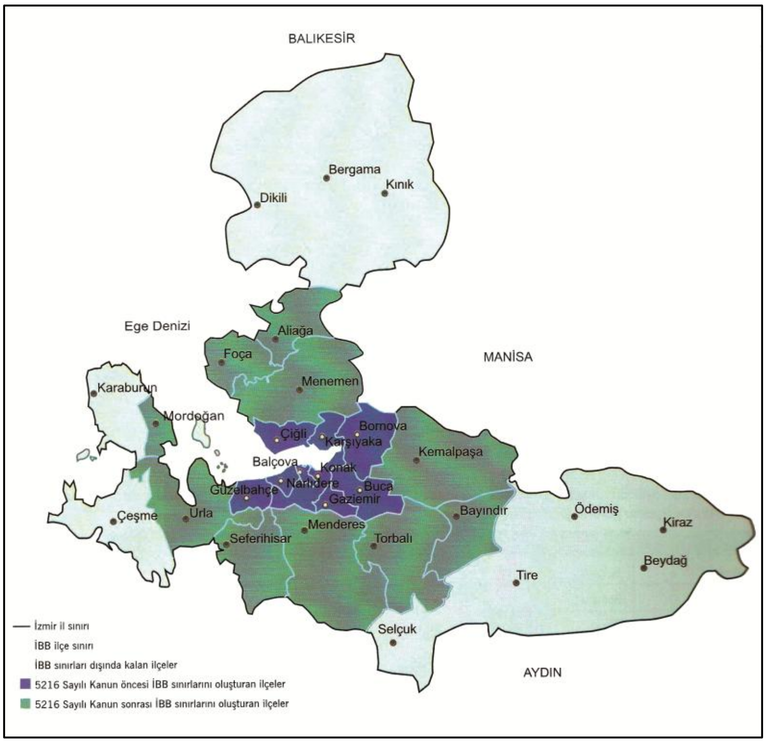


Figure 3.2.Districts of Izmir 2010

3.2. Research Data

Data of the thesis is defined in two part called cancer data and digital data.

3.2.1. Cancer Data

ICRC has recorded approximately 200.000 cancer data approved by the WHO since 1992. 20.000 of these data are lung cancer cases and received from ICRC to use in the study. The cancer data consists of demographic data, diagnostic method data and treatment data as attribute. The data includes also the medical records by active cancer registration system (hospitals, clinics, doctor's offices, pathology laboratories, radiation (oncology, therapy centers) and the medical centers (medical oncology centers, Nursing homes, Forensic Medical Center and death certificates). Collected cancer data (Table 3.2) are all recorded by the CanReg software. Figures 3.3, 3.4 and 3.5 show an example of CanReg software register and case record form used by ICRC.

Table 3.2. Cancer Data

Demographic Data	Diagnostic Methods	Treatment Data
Address, street, neighborhood, town place of birth, age at diagnosis date of birth, gender	Anatomical (topographic) place, histological (morphological) type behavior, grade, laterality, tumor order, stage at diagnosis	Surgical, radiotherapy, chemotherapy hormone therapy, immunotherapy other therapies, treatment history (dates), surgery and radiation order

Figure 3.3. CanReg software

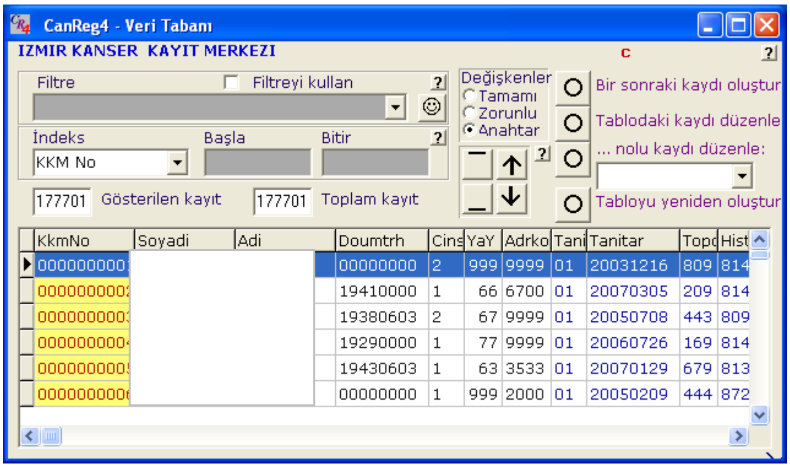
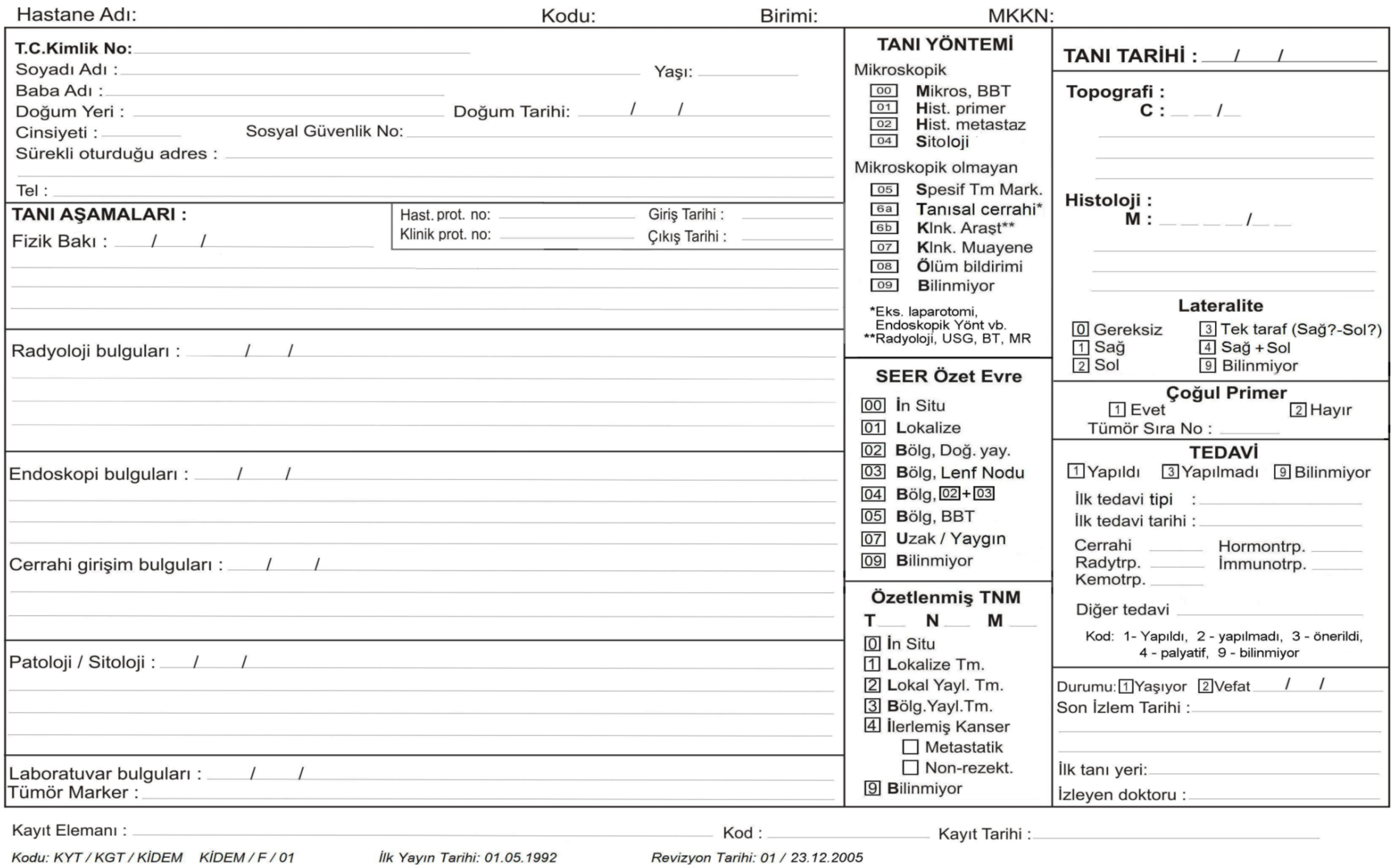


Figure 3.4. Database example from CanReg



Hastane Adı: Kodu: Birimi: MKKN:

T.C.Kimlik No:
Soyadı Adı : Yaşı:
Baba Adı :
Doğum Yeri : Doğum Tarihi: / /
Cinsiyeti : Sosyal Güvenlik No:
Sürekli oturduğu adres :
Tel :

TANI AŞAMALARI :
Hast. prot. no: Giriş Tarihi :
Klinik prot. no: Çıkış Tarihi :
Fizik Bakı : / /

Radyoloji bulguları : / /

Endoskopi bulguları : / /

Cerrahi girişim bulguları : / /

Patoloji / Sitoloji : / /

Laboratuvar bulguları : / /
Tümör Marker :

TANI YÖNTEMİ
Mikroskopik
00 Mikros, BBT
01 Hist. primer
02 Hist. metastaz
04 Sitoloji
Mikroskopik olmayan
05 Spesif Tm Mark.
6a Tanısal cerrahi*
6b Klnk. Araşt**
07 Klnk. Muayene
08 Ölüm bildirimi
09 Bilinmiyor
*Eks. laparotomi, Endoskopik Yönt vb.
**Radyoloji, USG, BT, MR

SEER Özet Evre
00 İn Situ
01 Lokalize
02 Bölg, Doğ. yay.
03 Bölg, Lenf Nodu
04 Bölg, 02+03
05 Bölg, BBT
07 Uzak / Yaygın
09 Bilinmiyor

Özetlenmiş TNM
T__ N__ M__
0 İn Situ
1 Lokalize Tm.
2 Lokal Yayl. Tm.
3 Bölg.Yayl.Tm.
4 İlerlemiş Kanser
☐ Metastatik
☐ Non-rezekt.
9 Bilinmiyor

TANI TARİHİ : / /

Topografi :
C : __ __ /__

Histoloji :
M : __ __ __ __ /__ __

Lateralite
0 Gereksiz
1 Sağ
2 Sol
3 Tek taraf (Sağ?-Sol?)
4 Sağ + Sol
9 Bilinmiyor

Çoğul Primer
1 Evet 2 Hayır
Tümör Sıra No :

TEDAVİ
1 Yapıldı 3 Yapılmadı 9 Bilinmiyor
İlk tedavi tipi :
İlk tedavi tarihi :
Cerrahi Hormontrp.
Radytrp. İmmunotrp.
Kemotrp.
Diğer tedavi
Kod: 1- Yapıldı, 2 - yapılmadı, 3 - önerildi, 4 - palyatif, 9 - bilinmiyor

Durumu: 1 Yaşıyor 2 Vefat / /
Son İzlem Tarihi :
İlk tanı yeri:
İzleyen doktoru :

Kayıt Elemanı : Kod : Kayıt Tarihi :

Kodu: KYT / KGT / KİDEM KİDEM / F / 01 İlk Yayın Tarihi: 01.05.1992 Revizyon Tarihi: 01 / 23.12.2005

Figure 3.5. Cancer registration form

3.2.2. The Population Data

The 2000, 2004 and 2007 general census data of Izmir Metropolitan Municipality data was received from Izmir Metropolitan Municipality. According to the general population census of TSI,Izmir Metropolitan Municipality 9 districts population was 1.780.476 persons in 1990 and 2.232.265 persons in 2000. In 2004, Izmir Metropolitan Municipality boundary has expanded to 19 districts and according to the TSI address-based population registration system. In 2007, Izmir Metropolitan Municipality 19 districts population was 3.256.536 persons. Population within the boundaries of Izmir Metropolitan Municipality constituted 66.07% of the population of Izmir in 1990 and 87.09% in 2007, due to boundary changes. As of 2007, Izmir total population was 3.739.353 persons (shown in Figure 4.2, in Chapter 4).

As presented in Table 3.3 and 3.4 (ICRC, 27.04.2011) and Graph 3.1, when the three main age groups is observed within the boundaries of Izmir Metropolitan Municipality, 0-14 age group has decreased by the rate of 14.38% in Izmir Metropolitan Municipality 9 districts and 13.67% in Izmir Metropolitan Municipality 19 districts from 2000 to 2007. In the same period it is seen that the share of, economically active, 15-65 age group in the total population has not changed. However, 65+ age group have increased by the rate of 23.15% in Izmir Metropolitan Municipality 9 districts and 20.92 % in Izmir Metropolitan Municipality 19 districts. According to the TSI address-based population registration system 2007, the districts that have more than 10% share of population of 65+ group are Karaburun with 18.62%, Bayindir with 13.66%, Urla with 10.49% and Balcova with 10.31%. In Table 3.5 main age ranges are given.

The annual population growth rate in Izmir Metropolitan Municipality is detected higher than that observed in Turkey between the years 1990-2000. In this period the annual population growth rate is 24.44% in Izmir Metropolitan Municipality 9 districts, however, the rate is 18.29% in Izmir Metropolitan Municipality 19 districts in the period of 2000-2007. When the assessment is made on the basis of districts, according to the census data, the population growth rate is highest in the first four districts Torbali, Buca, Cigli and Gaziemir (İBŞB, 2007b).

Table 3.3.Age groups population (1995 - 2000)

	1995		1996		1997		1998		1999		2000	
Age ranges	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0-4:	118250	114184	121220	116174	121945	116664	122482	117223	123992	118110	124893	119265
5-9:	123262	119929	125084	121041	126310	121555	126623	121783	129718	125534	132188	126954
10-14:	139961	135785	141620	137192	140432	136546	140190	135902	141913	136703	139665	134751
15-19:	140481	137238	146399	143853	150957	147308	153215	149567	154749	150927	156464	151112
20-24:	134699	143747	143216	151635	148706	154194	154023	158759	157974	161556	160826	164063
25-29:	131450	133697	135827	137284	142917	143471	145991	146913	151902	152671	157352	157020
30-34:	132793	129633	135450	133955	136086	134019	139381	137288	142181	139366	140914	138553
35-39:	119274	113649	121860	116131	125677	120943	129204	125028	134224	130337	137659	134072
40-44:	104781	98548	109569	104176	114086	108592	117458	112561	120426	114406	122951	117409
45-49:	84034	77694	87840	81146	93123	86677	96748	91053	102118	96271	106456	100889
50-54:	69412	65103	71732	66886	74828	71116	79587	77362	84172	81748	89013	87627
55-59:	56927	56883	58306	57103	60676	59818	62025	61184	64287	63842	67250	65839
60-64:	50833	51193	50357	51977	50660	53325	52182	55635	53238	57256	54647	58732
65-69:	38869	40587	40104	42324	41208	44867	43715	47182	45361	49651	45546	50107
70-74:	20618	21592	22490	23735	25502	27721	27964	31521	29751	34119	32231	37933
75-79:	9780	11560	10334	12517	11489	13868	12834	15086	14191	16999	15531	18576
80-84:	6306	8049	5761	7518	5742	7674	5743	7867	5518	7537	5984	8388
85+:	3186	4791	3278	5060	3528	5459	3513	5492	3447	5310	3854	5951

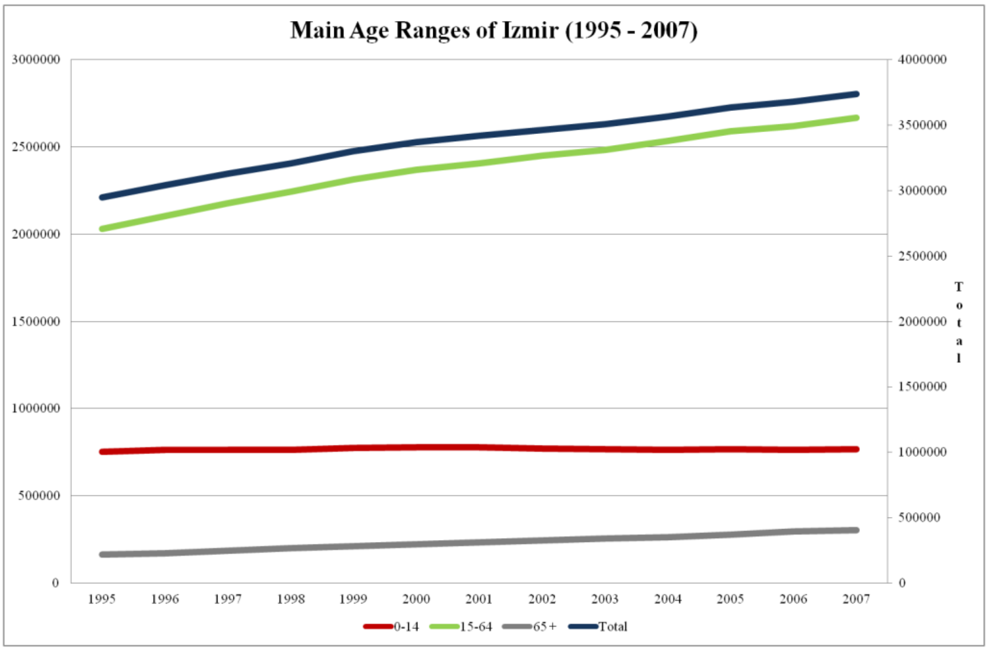
Table 3.4.Age groups population (2001 - 2007)

	2001		2002		2003		2004		2005		2006		2007	
Age ranges	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0-4:	125779	119683	122748	117489	119853	114164	118110	112382	117619	112023	117187	112615	119661	112912
5-9:	131616	126607	131917	126151	133847	127455	134148	127325	133612	127462	134055	127581	132613	125150
10-14:	139901	134468	138824	133339	138818	133346	139707	133655	141321	134816	139211	132948	142688	134289
15-19:	154019	149093	151753	145395	151024	144827	150262	144289	150338	144066	148037	142389	148470	140435
20-24:	163138	166029	166630	168551	166929	169160	169341	170981	168987	170747	162622	167507	171576	153898
25-29:	159203	158650	160662	158267	163435	160450	166332	163525	170415	167706	172509	173602	177538	172552
30-34:	142309	139193	146496	143772	148726	146557	153449	151623	157945	155384	159078	159290	160975	160102
35-39:	138615	136363	137614	136248	138746	136752	140139	138362	141234	139358	140636	138723	145248	146362
40-44:	124516	119042	127104	123504	130271	126532	133614	131393	136076	134493	137775	138767	138291	138990
45-49:	111112	106433	114649	109980	116457	111410	118927	113994	122544	117459	122722	120797	131163	129416
50-54:	92956	91464	96755	96832	99710	101337	103620	104876	106404	108546	111908	113974	115680	115308
55-59:	69928	69043	73017	72286	76383	75861	79152	79605	84391	85751	88151	89233	91907	92767
60-64:	56143	59467	58356	61415	58805	61333	60110	62914	62698	64925	65546	67227	66577	69376
65-69:	45717	51284	46573	52218	46551	53029	46599	53451	49010	55764	50752	56655	48895	55102
70-74:	33906	40026	34700	41349	36212	43141	37771	45213	377792	45280	38914	47579	37434	46939
75-79:	17296	20981	19091	23776	20625	26654	21812	28705	24272	32019	25594	35402	25313	37928
80-84:	6766	9217	7528	9822	7945	10911	8874	12203	9705	13232	11405	16843	13498	24026
85+:	3990	6238	3721	6050	3522	5894	3649	6164	4317	7255	5273	8778	5052	11222

Table 3.5. Main age ranges (1995 - 2007)

Main age ranges	1995	1996	1997	1998	1999	2000
0-14	751371	762331	763452	764203	775970	777716
15-64	2032069	2104702	2177179	2245164	2313651	2368848
65 +	165338	173121	187058	200917	211884	224101

Main age ranges	2001	2002	2003	2004	2005	2006	2007
0-14	778054	770468	767483	765327	766853	763597	767313
15-64	2406716	2449286	2484705	2536508	2589467	2620493	2666631
65 +	235421	244828	254484	264441	278646	297195	305409



Graph 3.1. Main age groups and total population change of Izmir (1995 - 2007)

3.2.3. Digital Data

The base Izmir digital data (Table 3.6) were obtained from the Basarsoft firm in May 2011. The baseline data categorizes as:The boundaries of province, districts, neighborhood – polygon data, (Figure 3.6, 3.7)Major Transportation Networks –

polyline data (Figure 3.8), Buildings – polygon data (Figure 3.9), Hospitals – point data (Figure 3.10). The data were in MapInfo format. Data files were converted into “Shape Files” to be used in ArcGIS software.

Table 3.6. Digital data layers

Data	Type	Attribute Information
Izmir Boundary	polygon	City name, area, boundary,
District map	polygon	County name, state code, county code, county area, circumference
District centre	point	County name, state code, county code, county area, circumference, the x centroid, y centroid
Roads	polyline	The road name, type, number of lanes, grade, length, description
Building	polygon	Road, street, door number, county, zip code
Neighborhood	polygon	Name, county name, area, circumference

Figure 3.6. Boundary of Districts

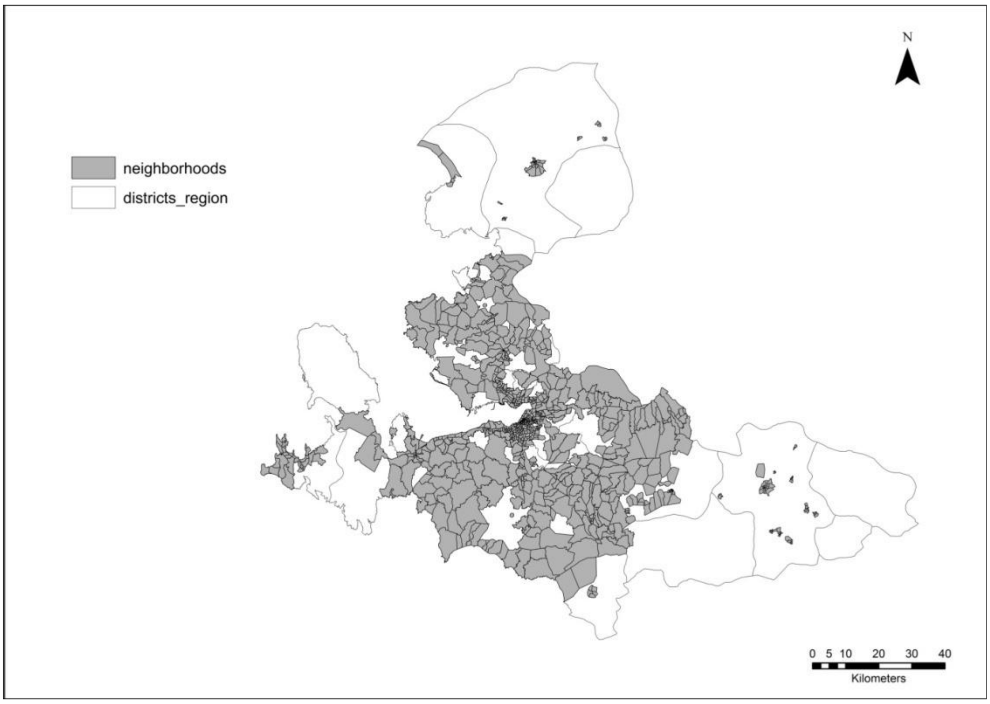


Figure 3.7. Boundary of Neighborhoods

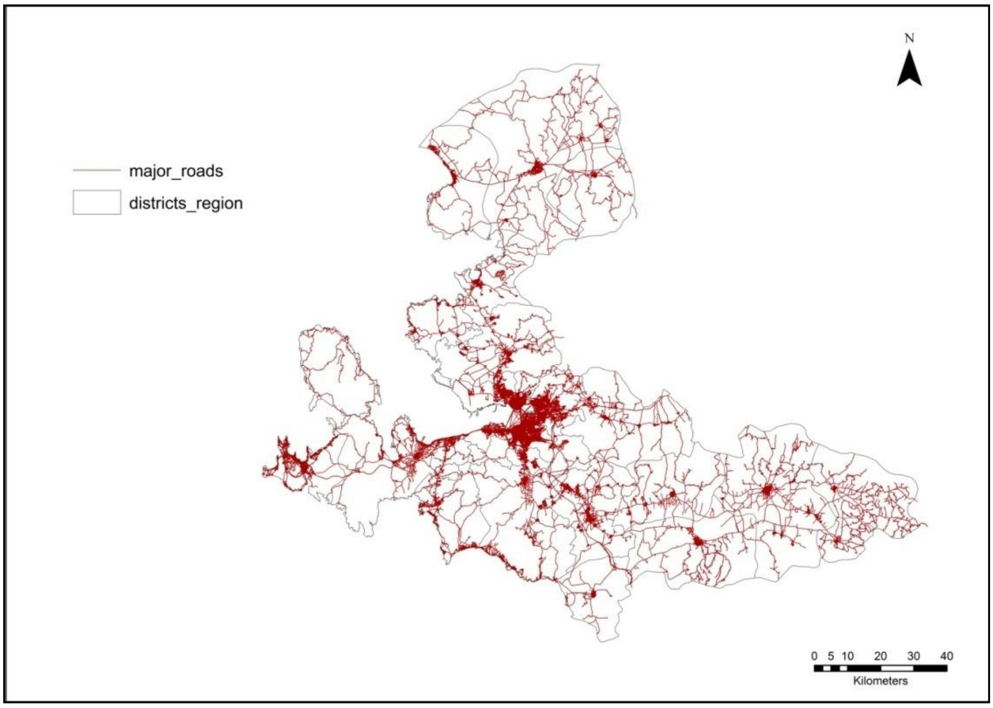


Figure 3.8. Major Transportation Networks

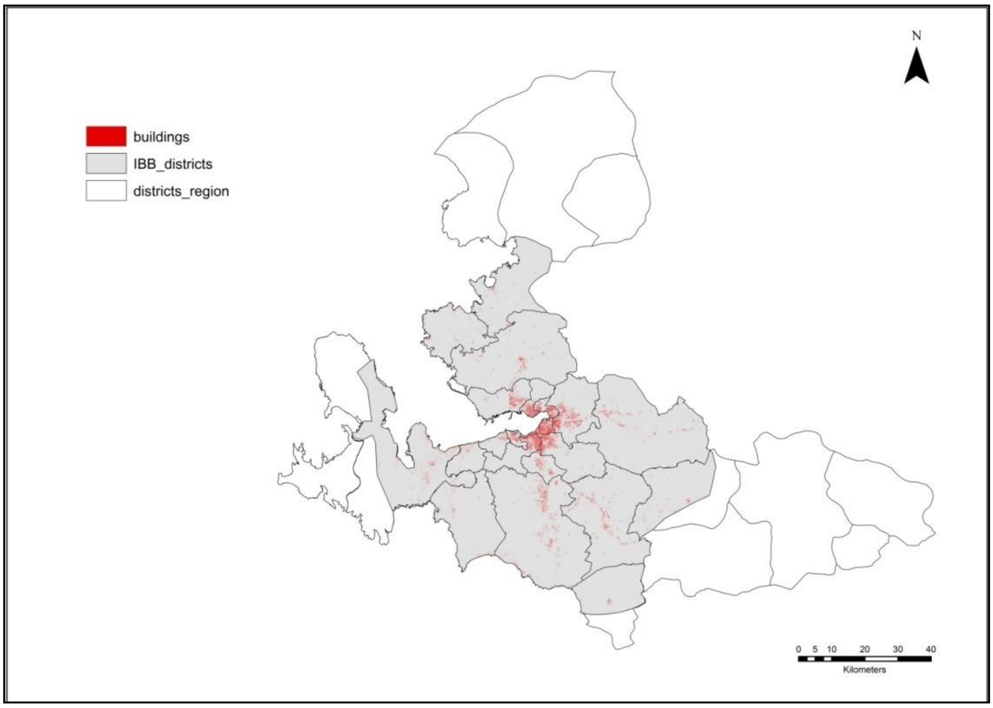


Figure 3.9. Boundaries of Izmir Metropolitan Municipality

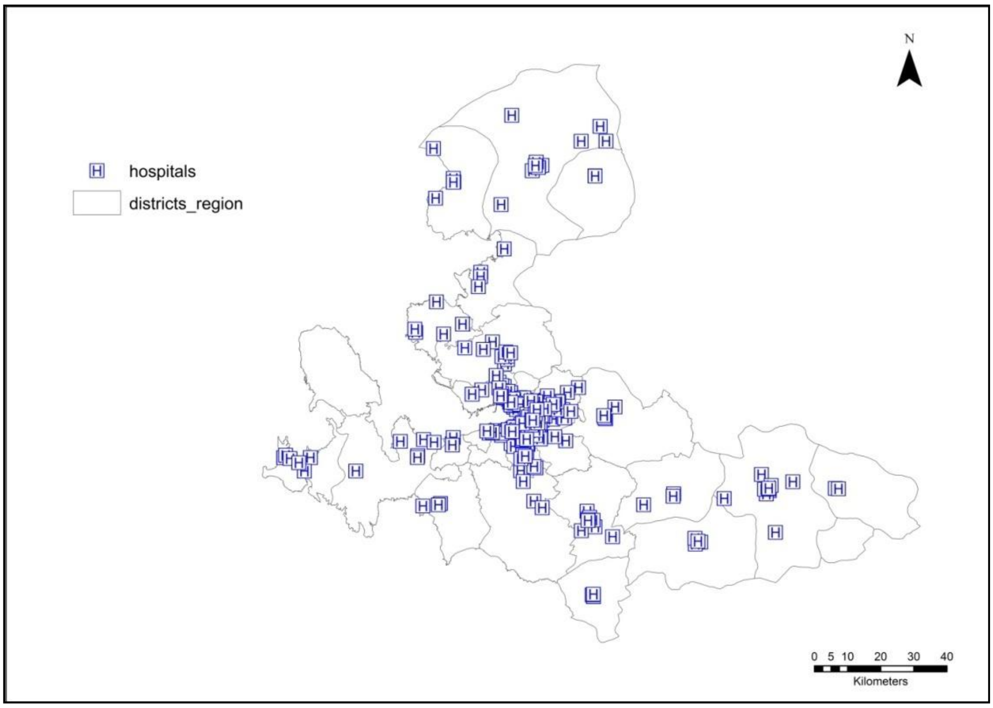


Figure 3.10. State of hospitals in Izmir Province

3.3. Limitations of Data

A. Limitations in Cancer Case Data

- Records of the address information are on a single line. Keeping a record of the address information on a single line is a constraint. While preparing the database, categorization address information column as avenue, street, number, apartment name, zip code and county has give the possibility of street-level inquiry (Table 3.7).
- Missing address data: In metropolitan area, the cases that contain only the name of neighborhood or district in the address column are shown in the centre of the settlement. On the other hand, in IBB districts, the cases that have street information without door number are shown in the relevant street center. Also the street information without neighborhood or districts is a constraint that's why there are many streets with same number in different districts (Table 3.8).
- Data out of the province of Izmir: Address line with the exception of the province of Izmir (Manisa, Aydın, Denizli) are not included in the study (Table 3.8).
- The situation of having duplications in data: Although there are few duplications, duplications were encountered in metropolitan districts data.

For all of these reasons, there are 1203 cases in Izmir Metropolitan Municipality and 34 cases in metropolitan districts that data input cannot be done to the base map. As a final product, 18044 of 19281 cases are pointed in the level of address information detail.

B. Limitations in Digital Data

- Missing door numbers of buildings in building layer
- Address data inputs are matched by giving odd number to the left facade buildings and even number to the right facade buildings of the street in case of missing door numbers.
- Absence of land use digital base
- Due to absence of land use base, Izmir City Surf and Google Earth were used as a guide.

Table 3.7. Research data set example

KkmNo	Doumtrh	Cins Kod	Cins	Yaş	Adres	Adres	mah	cadde	sokak	aptevno	Tanı Tarihi	Topografi
0000000431	19330717	1	Erkek	71	Bergama	GÖÇBEYLİ ATATÜRK M.BERGAMA C.N:2 BERG					20050506	BRONŞ VE AKCİĞER
0000000703	19380000	1	Erkek	65	Konak	681-1 SOK NO.7 ÇİMENTEPE	2.KADRİYE				20030708	BRONŞ VE AKCİĞER
0000000815	19480207	1	Erkek	59	Bergama	MALTEPE M. 14 EYLÜL C.N:3/2 BERGAMA					20070721	BRONŞ VE AKCİĞER
0000000972	19240000	1	Erkek	79	Bayındır	CANLI BELDESİ					20030320	BRONŞ VE AKCİĞER
0000000979	00000000	1	Erkek	999	Konak	1377 SK.NO2/7					20030626	BRONŞ VE AKCİĞER
0000001304	19610000	2	Kadın	45	Bergama	ATATÜRK MH.EMRE SK.NO:3 BERGAMA					20060531	BRONŞ VE AKCİĞER
0000001580	19330000	1	Erkek	70	Karşıyaka	7249 SK NO 10 KARŞIYAKA					20031003	BRONŞ VE AKCİĞER
0000001608	19440000	1	Erkek	60	Narlıdere				SEYİTHAN	13	20040302	BRONŞ VE AKCİĞER
0000001702	19380916	1	Erkek	63	BBT						20020516	BRONŞ VE AKCİĞER
0000001804	19290000	1	Erkek	73	Konak	BETONYOL/KONAK			249	43	20020701	BRONŞ VE AKCİĞER

Table 3.8. Research data set example -2

KkmNo	Doumtrh	Cins Kod	Cins	Yaş	Adres	Adres	mah	cadde	sokak	aptevno	Tanı Tarihi	Topografi
1998091303	19180000	1	Erkek	80	Ödemiş	YOLÜSTÜ KÖYÜ ÖDEMİŞ/İZMİR					19981005	BRONŞ VE AKCİĞER
1998095103	19550000	1	Erkek	42	Ödemiş	GERELİ KÖYÜ ÖDEMİŞ/İZMİR					19981108	BRONŞ VE AKCİĞER
2000054118	19520000	1	Erkek	49		GEMİŞ KASAB.ÇARDAK/DENİZLİ					20010706	BRONŞ VE AKCİĞER

3.4. The Methods to Conduct the Thesis

While trying to understand, document and formulize the relationship between urban environmental quality and cancer, the basic steps that are followed in the realization of the thesis is formulized as two main steps of abstract and concrete research as seen in the Fig.3.11. The research methodology figure shows the flow chart of the main frame of the thesis. While abstract research involves literature survey of theoretical background and reviews consist of World, Turkey cases and evaluations; concrete research includes extensive analysis in the context of cancer case data, output database andspatial pattern maps.

3.4.1. Abstract Research

Literature review is carried out to understand the basic structure of urban environmental quality, quality of life indicators with its relation human well-being and the links between health and healthy city planning in the context of theoretical background.Literature survey and review are carried out to examine previous dissertations, researches in the context of the concepts and issues mentioned above and evaluation processes. Case study reviews from world examples are conducted. Objective indicators of QOUL are determined in the case of Izmir. The theoretical sources are derived from related books, e-books, databases, previous dissertations, The Scientific and Technological Research Council of Turkey (TÜBİTAK) projects in Turkey, journals, books, e-books, web and other sources. The collected data in theoretical studies are mentioned and categorized as follows:

- The Concepts of Quality of Life And Environmental Quality
- Environmental Quality of Life
- Impacts of Environmental Factors
- Urban Planning and QOL – Environmental Quality Relation
- Investigating of Quality of Life
- Well-Being, Satisfaction, and Happiness Concepts
- Connections between Health and Urban Planning – Health Concept
- Historical Development of the Concept of Healthy City
- The Role of GIS in Environmental Health Research
- Cancer Statistics in The World – Turkey and Izmir

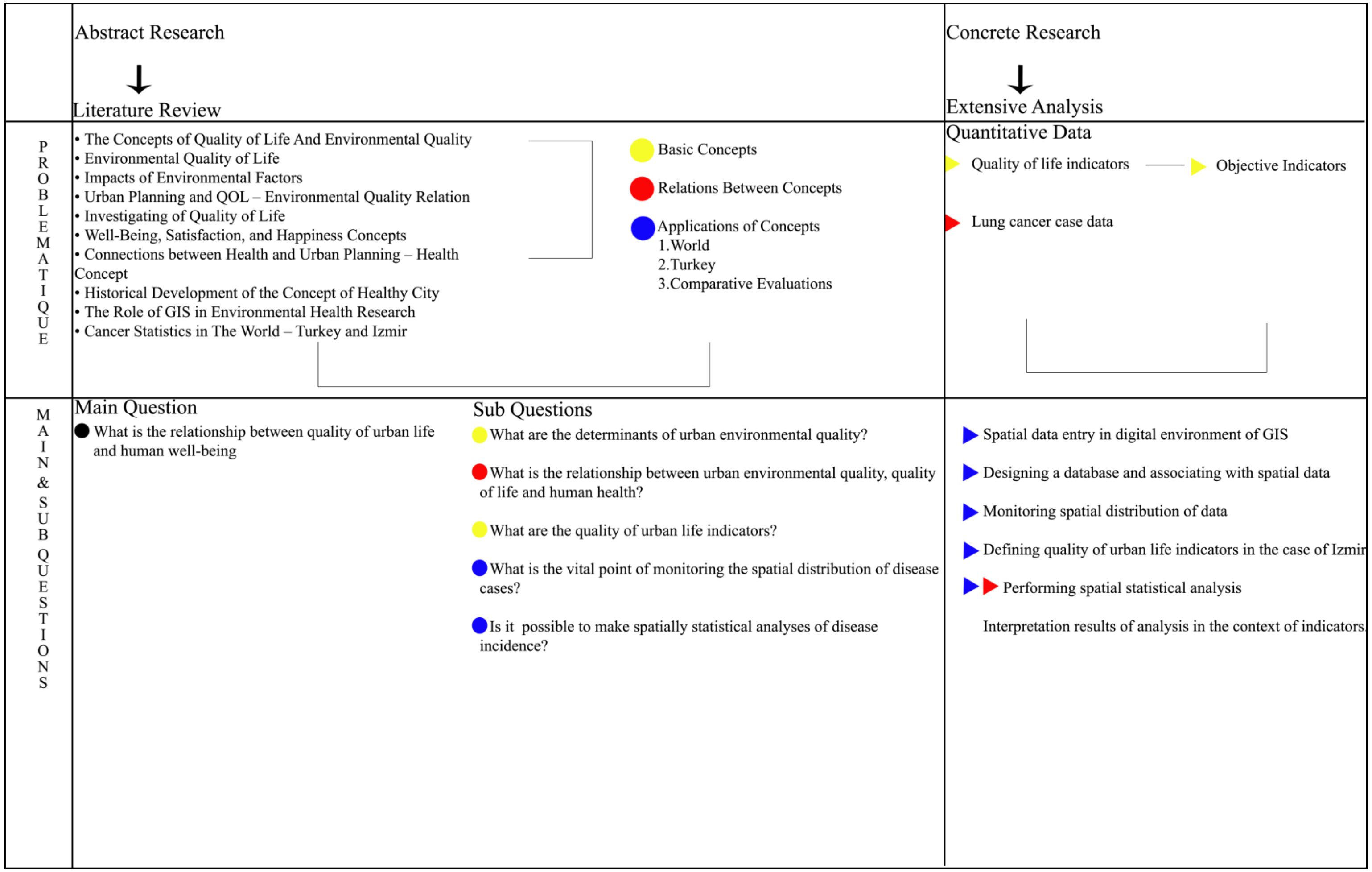


Figure 3.11. Methodology framework

3.4.2. Concrete Research

Within the framework of extensive analysis, the steps of the thesis in sequence:

1. Izmir environmental objective indicators from Izmir Metropolitan Municipality, TSI regional indicators statistics and cancer data from ICRC for province of Izmir are provided. Spatial distribution of cancer cases are monitored
2. Tabular cancer data are associated with digital based maps.
3. An appropriate database is designed by re-editing the collected cancer data for the aim of the study.
4. QOL indicators of Izmir are defined.
5. Spatial autocorrelation analysis for the cancer data is performed.
6. Specific site selection is determined by monitoring hot and cold spots of registered cancer cases that are spatially illustrated at the neighborhood level
7. Analysis and queries results are interpreted in the context of objective indicators.

Within the framework of theoretical study reviews, quality of life indicators and environmental factors are determined in the case of Izmir Province. The two issues overlapped and basic urban life quality indicators are determined.

Cancer data entry is performed to monitor spatial pattern of lung cancer. Cancer data of Izmir province is documented on annual bases and database is indexed. CanReg program is used for recording and has "mb0" extension as a file structure and direct conversion (export) cannot be done to the other database programs. Data can become ready to use only by copying and then transferring to a "text" or "excel" files. Afterwards, cancer data is transferred to a excel file. Duplications are eliminated, address information are separated into columns as main road, street, house number and apartment number.

In GIS based mapping; point, polyline and polygonlayers and related databases are used. Point layer is used particularly to show cancer cases in terms of patients' addresses. Relational database method that could connect points with polygons is used in the case of neighborhood basis data entry. In relation with this, the number of cases is counted on the basis of the districts and neighborhood. The point data and excel data are combined with the join and relate tool to create database. So the information relevant to each case becomes accessible and questionable in the digital environment. Population data in the scale of districts is added to the database. Due to the population data, crude incidence rate and age-standardized incidence rate of districts is calculated. As continuation of the process, smart maps with tabular data displaying distribution of cancer cases and thematic cancer incidence maps based on districts are generated.

Incidenceis a measure of theriskof developing some new condition within a specified period of time.The incidence rate is the number of new cases per population in a given time period. In other words, the basic incidence rate (sometimes called just incidence) is a measure of the frequency with which a disease occurs in a population over a period of time. The formula for calculating an incidence rate is:

$$Incidence\ Rate = \frac{new\ cases\ occuring\ during\ a\ given\ time\ period}{population\ at\ risk\ during\ the\ same\ period} \times 10^{n} \qquad (3.1.)$$

The numerator (x)should include only new cases of the disease that occurred during the specified period and should not include cases that occurred or were diagnosed earlier.The denominator (y) is the population at risk means that the people included in the denominator should be able to develop the disease in question during the time period covered. In practice, it is used census data for the denominator.The denominator should also represent the population from which the cases in the numerator arose. The population may be defined by geographic area (e.g., Izmir Province) or by membership in a specific group (e.g., x District). Incidence rates may be the single most important tool for epidemiologists looking to identify causes of disease or sources of risk. Comparing these rates from region to region and group to group can reveal important differences and lead to major discoveries.

In epidemiology age standardization is a technique used to better allow populations to be compared when the age profiles of the populations are quite different. In other words, age-standardized incidence rate (ASR) is the summary rate thatwould have been observed, given the schedule of age-specificrates, in a population with the age composition of some referencepopulation, often called the standard. The calculation of thestandardized rate is an example of direct standardization, wherebythe observed age-specific rates are applied to a standard population. The formula is given below to calculate the ASR, Where “di” is the number of cases “yi” is the number of person-years at risk. In this research context, n is assumed as 5 for calculation, therefore incidence rates are the frequency of per 100.000 people (http://www.iarc.fr/en/publications/pdfs-online/epi/sp155/ci5v8-chap8.pdf, 2013)

$$ASR = 10^n \times {(\sum_i y_i)}\Big/{(\sum_i d_i)} \qquad (3.2.)$$

The population data of 2000 and 2007 at the neighborhood level of Izmir Metropolitan Municipality have been taken from TSI in order to test whether there were clusters of high amount of incidence rate. With the 2000 and 2007 census data, the incidence rate of neighborhoods has been calculated by the database. In order to test spatial distribution of those incidence rates, spatial autocorrelation tool of spatial statistics is performed. Within the spatial autocorrelation method, theinverse distancemethod is usedsince it is most appropriate with continuous data or to model processes where the closer two features are in space, the more likely they are to influence each other. With this spatial conceptualization, every feature is potentially a neighbor of every other feature, and with large datasets, the number of computations involved is enormous. The distance band or threshold distance parameter is leaved blank.

The Spatial Autocorrelation measures feature similarity based on both feature locations and feature values. It evaluates whether the pattern expressed is clustered, dispersed, or random. The tool calculates the Moran's I Index value, z score and p value evaluating the significance of that index. In general, as in the normal distribution graph, a Moran's Index value near +1.0 indicates clustering while an index value near -1.0 indicates dispersion. The calculated z-scores and p values determines to place of features with either high or low values cluster spatially(Getis, 1995)

The p-value is a probability. For the pattern analysis tools, it is the probability that the observed spatial pattern was created by some random process. When the p-value is very small, it means it is very unlikely that the observed spatial pattern is the result of random processes, so the null hypothesis can be rejected.

Z-scores are simply standard deviations. Both z-scores and p-values are associated with the standard normal distribution. The Z score value is positive and it means that high values cluster together in the study area. This tool works by looking at each feature within the context of neighboring features. Also it can be showed that the distribution of the high and low valued incidence is clustered or random (Getis, 1995). Table 3.9(http://www.esri.com, 2013) summarizes interpretation of results.

Table 3.9. Interpretations of p and z value results

The p-value is *not* statistically significant.	You cannot reject the null hypothesis. It is quite possible that the spatial distribution of feature values is the result of random spatial processes. The observed spatial pattern of feature values could very well be one of many, many possible versions of complete spatial randomness (CSR).
The p-value *is* statistically significant, and the z-score is positive.	You may reject the null hypothesis. The spatial distribution of high values and/or low values in the dataset is more spatially clustered than would be expected if underlying spatial processes were random.
The p-value *is* statistically significant, and the z-score is negative.	You may reject the null hypothesis. The spatial distribution of high values and low values in the dataset is more spatially dispersed than would be expected if underlying spatial processes were random. A dispersed spatial pattern often reflects some type of competitive process—a feature with a high value repels other features with high values; similarly, a feature with a low value repels other features with low values.

The Moran's *I* statistic for spatial autocorrelation is given as (Getis, 1995):

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2} \qquad (3.3.)$$

Where z_i is the deviation of an attribute for future i from its mean $(x_i - \bar{X})$, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features, and S_0 is the aggregate of all the spatial weights:

$$S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} \tag{3.4.}$$

The z_I score for the statistic is computed as:

$$z_i = \frac{I - E\,[I]}{\sqrt{V[I]}} \tag{3.5.}$$

where:

$$E\,[I] = {}^{-1}\!/_{(n-1)}$$

$$V[I] = E\,[I^2] - E[I]^2$$

Additional calculations are as follows:

$$E\,[I^2] = \frac{A-B}{C} \tag{3.6.}$$

$$A = n\left[(n^2 - 3n + 3)S_1 - nS_2 + 3{S_0}^2\right]$$

$$B = D\left[(n^2 - n)S_1 - 2nS_2 + 6{S_0}^2\right]$$

$$C = (n-1)(n-2)(n-3){S_0}^2$$

$$D = \frac{\sum_{i=1}^{n} {z_i}^4}{(\sum_{i=1}^{n} {z_i}^2)^2}$$

$$S_1 = \left({}^{1}\!/_{2}\right) \sum_{i=1}^{n} \sum_{j=1}^{n} \left(w_{i,j} + w_{j,i}\right)^2 \tag{3.7.}$$

$$S_2 = \sum_{i=1}^{n} \left(\sum_{j=1}^{n} w_{i,j} + \sum_{j=1}^{n} w_{j,i}\right) \tag{3.8.}$$

During cluster analysis, to detect spatial pattern within local scale and to map the pattern, Getis-Ord Gi* (Hot Spot) statistics is calculated. The resultant z score tells where the features with either high values of incidence rate cluster spatially. The Gi* statistic returned for each feature in the dataset is a z score. For statistically significant positive z scores, when the z score gets larger, the more intense clustering of the high values occurs that meaning hot spot. For statistically significant negative z scores, when the the z score gets smaller, the more intense clustering of the low values occurs that meaning cold spot (Getis, 1995)

The Getis-Ord local statistic is given as (Getis, 1995):

$$G_i{}^* = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}{}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2\right]}{n-1}}} \quad (3.9.)$$

Where x_i is the attribute value for feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_i}{n}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j{}^2}{n} - (\bar{X})^2}$$

The $G_i{}^*$ statistic is a z-score so no further calculations are required.

CHAPTER 4

SPATIAL POINT PATTERN ANALYSIS OF LUNG CANCER IN IZMIR

In this chapter, spatial point pattern of the lung cancer cases in Izmir is demonstrated. Approximately 18.000 lung cancer cases are geocoded addresses using ArcGIS 10.1 on street level database. Figure 4.1 shows the spatial point pattern of the lung cancer cases within Izmir Province map. Izmir Metropolitan Municipality borders show as gray tone and detailed at the right side of the figure. Additionally, Figure 4.2 and 4.3 represent the distribution of lung cancer cases on Google Earth imagery. Most cases have just district name in the address information form as full address especially in Izmir Province, because of this, lung cancer case data located in the center of the district settlement on digital map. Thus, it is observed that the central parts of the city have the most intense areas. In Izmir Metropolitan Municipality, Konak is the most intense district in terms of pattern of the cases.

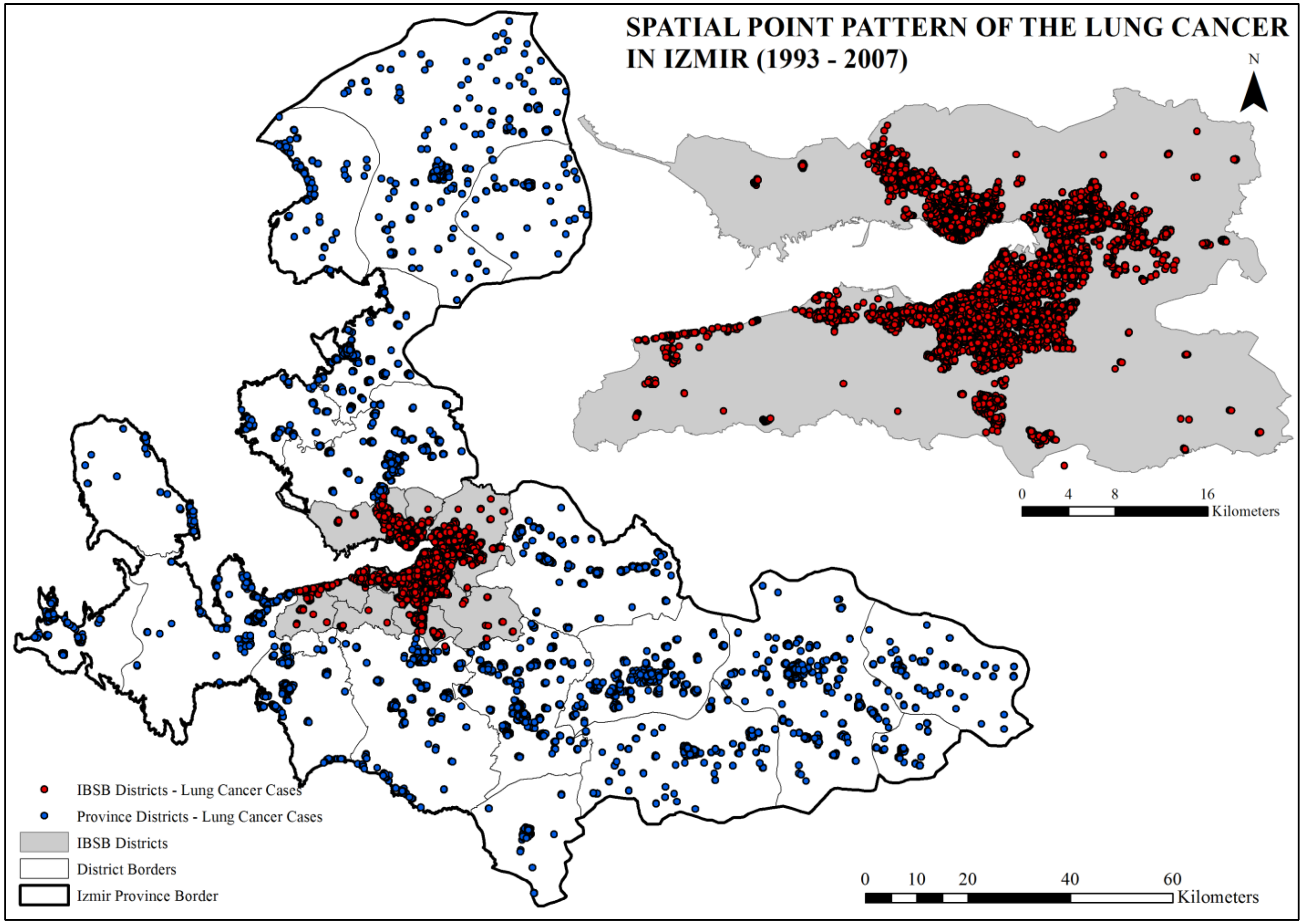


Figure 4.1. Spatial point pattern of the lung cancer in Izmir (1993-2007)

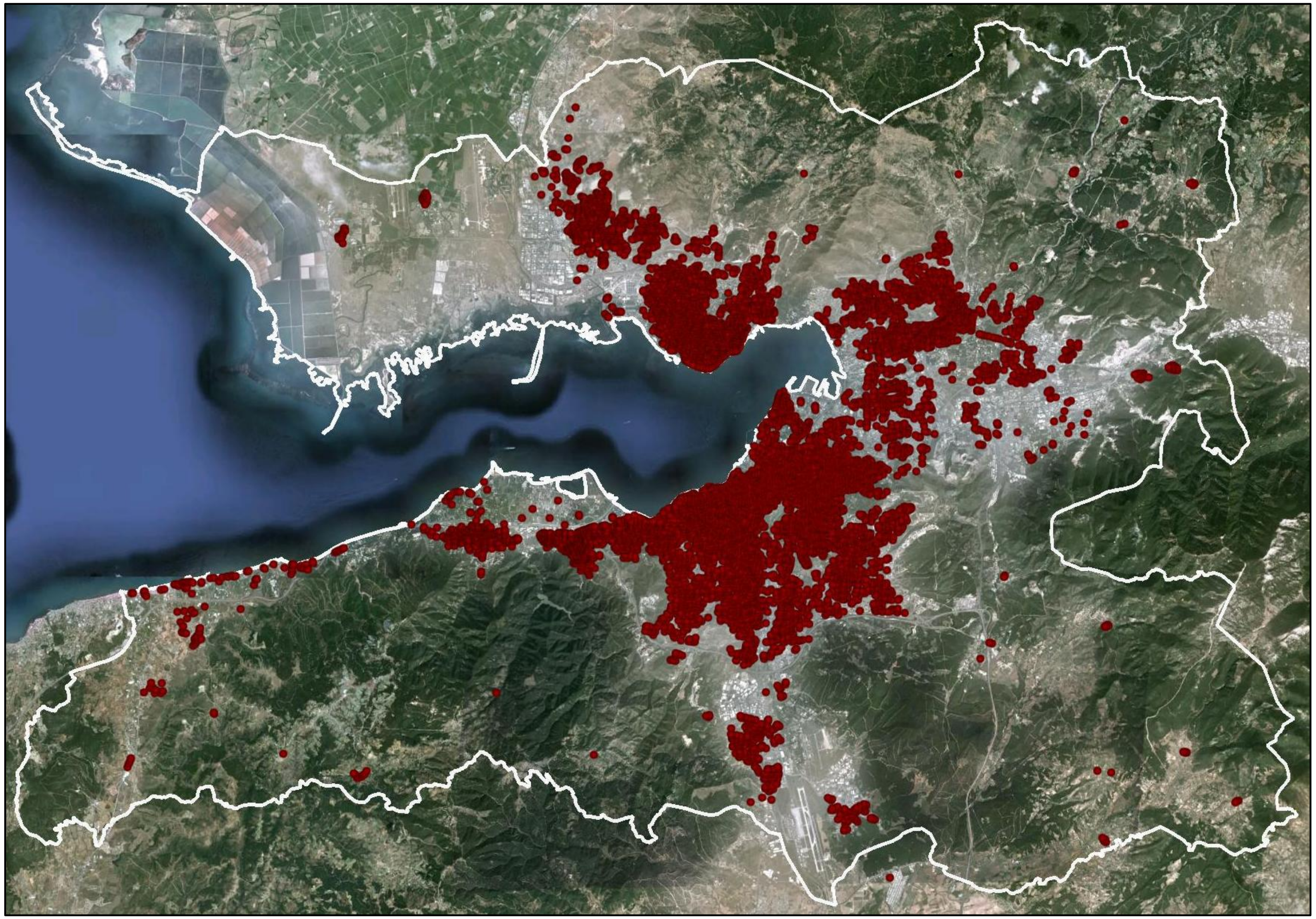


Figure 4.2. Izmir Metropolitan Municipality – the lung cancer spatial point pattern from Google Earth

Figure 4.3. Izmir Province Area – the lung cancer spatial point pattern from Google Earth

4.1.Incidence Statistics of the Lung Cancer

There are 28 districts in Izmir and the total numbers of lung cancer case is shown in Table 4.1 which have been registered between 1995-2007 years by ICRC. There are a total of 18.045 cancer cases within Izmir area. Approximately 13.000 out of 18.000 cases (67 %) were registered within Izmir Metropolitan Municipality and5000 cases (33%)were registered in other districts in Izmir Province. The number of registered cases has dramatically increased to 149 % from 1995 to 2007 case numbers. It is noticed that the total increase trend it is almost linear trend line. The maximum increase rate of case is observed in Seferihisar within the metropolitan area while it is observed in Gaziemir within Izmir Metropolitan Municipality boundary. The minimum increase rate is observed in Beydag in metropolitan area and in Guzelbahce in Izmir Metropolitan Municipality boundary.

According to the general population census of Turkish Statistical Institute (TSI) Izmir Metropolitan Municipality 9 districts population was 1.780.476 persons in 1990 and 2.232.265 persons in 2000. In 2004, Izmir Metropolitan Municipality boundary has expanded to 19 districts. In 2007, Izmir Metropolitan Municipality 19 districts population was 3.256.536 persons. Population within the boundaries of Izmir Metropolitan Municipality constituted 66.07% of the population of Izmir in 1990 and 87.09% in 2007, due to boundary changes. As of 2007, as observed in Table 4.2, Izmir total population was 3.800.760 persons. The increase rate of total population is observed as 28% between 1995 and 2007.

The annual population growth rate in Izmir Metropolitan Municipality is detected higher than that observed in Turkey between the years 1990-2000. In this period the annual population growth rate is 2.44% in Izmir Metropolitan Municipality 9 districts, however, the rate is 1.83% in Izmir Metropolitan Municipality 19 districts in the period of 2000-2007. When the assessment is performed on the basis of districts, according to the census data, the population growth rate is the highest in the first four districts Torbali, Buca, Cigli and Gaziemir between 2000 and 2007(İBŞB, 2007b).

Between 1995 and 2007, the maximum growth rate is observed in Foca within metropolitan area, in Gaziemir within Izmir Metropolitan Municipality districts. Besides the minimum growth rate is observed in Odemis in metropolitan area, in Konak in Izmir Metropolitan Municipality districts. However, in Beydag and Kinik of metropolitan districts, a decrease is observed in population between 1995 and 2007.

Within the scale of Izmir area with its 28 districts, the crude incidence rate of lung cancer cases are shown in the Table 4.3, ASR of lung cancer cases are shown in the Table 4.4 between 1995-2007 years. According to the ASR, 40% increase is observed in average number of ASR across the province while 23% increase is observed within the Izmir Metropolitan Municipality of 1995-2007. According to the crude incidence rate, 84% increase is observed across the province while 75% increase is observed within the Izmir Metropolitan Municipality.

The highest ASR is observed in mostly Gaziemir and Konak within Izmir Metropolitan Municipality, in mostly Cesme and Urla within metropolitan districts. However, the highest crude incidence rate is observed in mostly Konak within Izmir Metropolitan Municipality, in mostly Karaburun and Bayindir within metropolitan districts. Graphs 4.1 – 4.13 present the crude incidence and ASR incidence of Izmir from 1995 to 2007 as graphically. Additionally, Figures 4.4 – 4.7 show the thematic maps of these rates.

Table 4.1. Case numbers of the lung cancer in Izmir (1995-2007)

District Name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Aliaga	6	8	11	13	19	19	21	17	23	31	20	23	20	**231**
Balcova	25	28	28	28	30	35	37	43	37	38	39	53	58	**479**
Bayindir	17	24	32	21	16	35	36	24	19	21	43	27	33	**348**
Bergama	29	26	36	31	37	44	46	50	36	48	42	66	64	**555**
Beydag	4	1	4	3	1	2	9	4	3	4	7	2	6	**50**
Bornova	60	72	79	99	74	99	131	167	148	168	186	189	184	**1656**
Buca	71	74	99	109	105	126	94	138	127	150	152	190	171	**1606**
Cesme	2	6	7	10	8	14	8	7	8	16	13	17	19	**135**
Cigli	17	28	23	22	28	37	44	45	47	67	54	78	53	**543**
Dikili	8	9	10	10	7	22	19	9	15	15	23	15	14	**176**
Foca	4	2	5	9	10	7	12	4	11	14	9	7	11	**105**
Gaziemir	7	18	21	20	25	29	18	29	35	47	32	34	33	**348**
Guzelbahce	4	5	6	3	7	7	9	8	4	9	9	7	7	**85**
Karaburun	3	2	2	5	1	3	1	5	4	5	4	9	7	**51**
Karsiyaka	87	101	140	140	142	164	183	206	203	238	227	241	221	**2293**
Kemalpasa	12	15	18	16	22	31	16	28	32	37	49	38	52	**366**
Kinik	9	13	8	15	5	18	18	13	13	9	12	18	14	**165**
Kiraz	5	8	10	8	5	9	12	11	7	19	18	17	14	**143**
Konak	259	268	384	348	383	454	402	513	466	513	473	474	573	**5510**
Menderes	6	13	22	21	14	29	30	16	27	20	35	36	37	**306**
Menemen	26	24	20	14	30	29	40	48	46	41	44	59	59	**480**
Narlidere	15	16	18	5	17	19	14	26	27	31	24	31	30	**273**
Odemis	35	30	43	42	48	45	48	52	68	69	64	66	73	**683**
Seferihisar	0	7	5	8	9	7	13	9	10	15	11	16	13	**123**
Selcuk	2	9	6	9	11	15	12	11	20	20	14	14	22	**165**
Tire	27	23	21	19	23	43	29	35	30	37	39	60	58	**444**
Torbali	21	23	28	13	26	33	39	40	35	38	46	37	53	**432**
Urla	12	18	16	10	17	32	17	23	21	26	31	35	35	**293**
Total	**773**	**871**	**1102**	**1097**	**1120**	**1407**	**1358**	**1581**	**1522**	**1746**	**1720**	**1859**	**1934**	**18044**

Table 4.2. Population of Izmir (1995-2007)

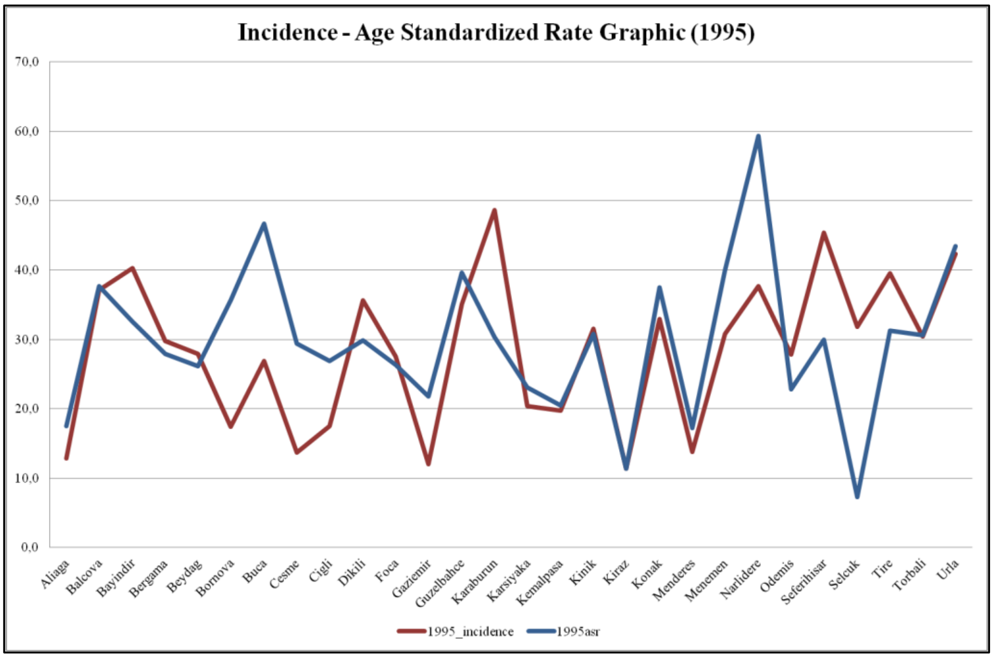
	POPULATION OF IZMIR												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Aliaga	46494	45851	48099	48053	49542	51827	53406	54254	55338	56421	56882	58186	60043
Balcova	67300	69033	69345	71167	72981	72586	73313	73283	74524	75320	75448	75497	74837
Bayindir	42192	41575	41218	41119	40974	41295	41026	41295	41363	42118	41985	42561	42152
Bergama	97256	97313	98122	99004	101160	101703	100414	100281	101173	101286	101933	101757	102581
Beydag	14316	14684	14701	14325	13988	14062	14085	14053	14067	14094	14089	14122	13500
Bornova	344791	357317	365602	382637	404134	422237	432784	440242	445911	453880	464166	470645	476153
Buca	263847	276707	291315	303448	314946	329265	340487	352054	360111	370901	381959	376189	400930
Cesme	14616	15320	15096	15064	15847	17629	18186	19466	20186	20851	21370	22084	27796
Cigli	97268	98586	100153	101880	109108	114894	117028	120246	126035	130179	134857	137847	144251
Dikili	22427	23111	23821	24424	24990	25168	25846	26103	26073	26129	26506	28119	27348
Foca	14528	14770	14701	14892	15470	16057	16284	16860	17191	17492	17534	17444	30549
Gaziemir	58036	63818	67553	72444	80191	84326	87223	89203	92282	95395	99367	101843	109291
Guzelbahce	11397	11868	12351	12496	12852	13048	13250	14136	14787	15430	16226	17161	19255
Karaburun	6161	6089	6225	6175	6328	7356	7776	7223	7252	7118	7111	7799	8040
Karsiyaka	426352	443804	456388	467867	479265	479802	487122	491501	494810	503903	510504	522698	557336
Kemalpasa	60840	62340	64068	65886	67707	68819	70709	71722	72841	74463	76810	79361	81777
Kinik	28532	28777	28558	28118	28083	28083	27962	27691	27651	27997	28129	27527	27938
Kiraz	43803	44599	44894	45062	44690	44690	44809	46289	45653	45766	45890	45957	45072
Konak	785687	807200	831233	850918	860579	862805	864175	862042	864170	869394	881235	885399	867481
Menderes	43405	47650	50535	49169	54461	54461	57701	59109	60267	61031	61759	63221	64065
Menemen	84354	87481	91416	96361	99019	99019	106695	111023	112736	115661	120640	125990	126934
Narlidere	39814	40833	42135	44127	44416	45782	47377	47945	49064	51406	51844	52132	61455
Odemis	125967	127281	127348	127154	125817	125817	126264	124912	125612	124706	126283	126302	128253
Seferihisar	15414	16369	17527	18075	18238	18238	20036	20560	20593	20734	21076	22276	25830
Selcuk	28243	28689	28914	29906	30769	30769	30865	32086	31592	32257	32669	32866	34002
Tire	68332	67617	70873	71041	71565	71565	71478	71851	71883	72699	73454	73842	76327
Torbali	69090	72188	74965	78715	81567	81567	87737	91436	95087	99448	103363	109212	119506
Urla	28346	29284	30533	30757	32818	32818	36153	37716	38420	40197	41877	43248	48058

Table 4.3.Crude incidence of the lung cancer in Izmir (1995-2007)

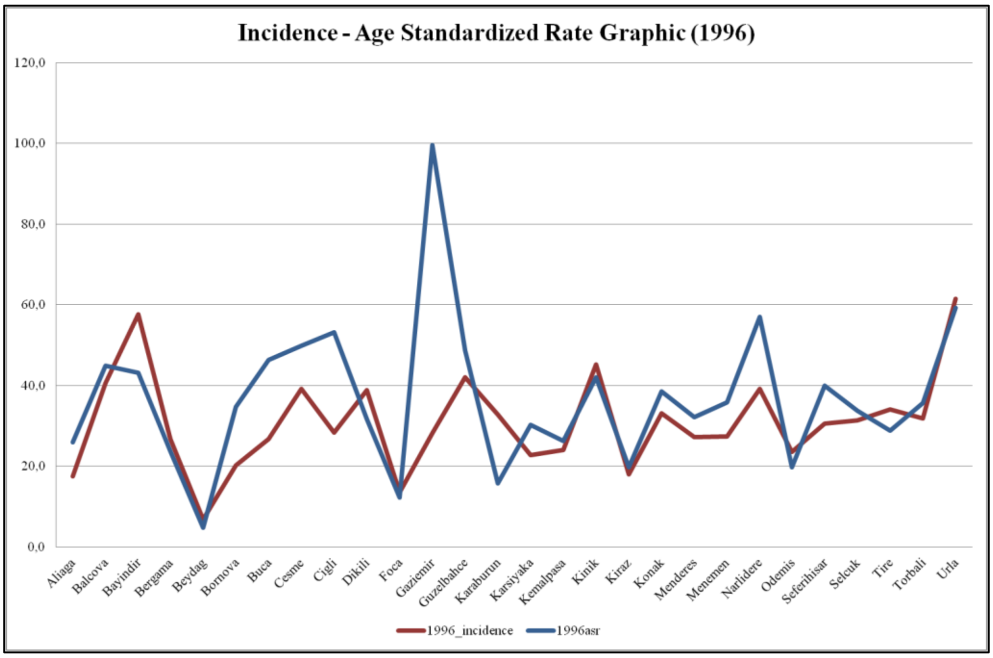
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Aliaga	12,90	17,45	22,87	27,05	38,35	36,66	39,32	31,33	41,56	54,94	35,16	39,53	33,31
Balcova	37,15	40,56	40,38	39,34	41,11	48,22	50,47	58,68	49,65	50,45	51,69	70,20	77,50
Bayindir	40,29	57,73	77,64	51,07	39,05	84,76	87,75	58,12	45,93	49,86	102,42	86,93	78,29
Bergama	29,82	26,72	36,69	31,31	36,58	43,26	45,81	49,86	35,58	47,39	41,20	64,86	62,39
Beydag	27,94	6,81	27,21	20,94	7,15	14,22	63,90	28,46	21,33	28,38	49,68	14,16	44,44
Bornova	17,40	20,15	21,61	25,87	18,31	23,45	30,27	37,93	33,19	37,01	40,07	40,16	38,64
Buca	26,91	26,74	33,98	35,92	33,34	38,27	27,61	39,20	35,27	40,44	39,79	50,51	42,65
Cesme	13,68	39,16	46,37	66,38	50,48	79,41	43,99	35,96	39,63	76,73	60,83	76,98	68,36
Cigli	17,48	28,40	22,96	21,59	25,66	32,20	37,60	37,42	37,29	51,47	40,04	56,58	36,74
Dikili	35,67	38,94	41,98	40,94	28,01	87,41	73,51	34,48	57,53	57,41	86,77	53,34	51,19
Foca	27,53	13,54	34,01	60,44	64,64	43,59	73,69	23,72	63,99	80,04	51,33	40,13	36,01
Gaziemir	12,06	28,21	31,09	27,61	31,18	34,39	20,64	32,51	37,93	49,27	32,20	33,38	30,19
Guzelbahce	35,10	42,13	48,58	24,01	54,47	53,65	67,92	56,59	27,05	58,33	55,47	40,79	36,35
Karaburun	48,69	32,85	32,13	80,97	15,80	40,78	12,86	69,22	55,16	70,24	56,25	115,40	87,06
Karsiyaka	20,41	22,76	30,68	29,92	29,63	34,18	37,57	41,91	41,03	47,23	44,47	46,11	39,65
Kemalpasa	19,72	24,06	28,10	24,28	32,49	45,05	22,63	39,04	43,93	49,69	63,79	47,88	63,59
Kinik	31,54	45,17	28,01	53,35	17,80	64,10	64,37	46,95	47,01	32,15	42,66	65,39	50,11
Kiraz	11,41	17,94	22,27	17,75	11,19	20,14	26,78	23,76	15,33	41,52	39,22	36,99	31,06
Konak	32,96	33,20	46,20	40,90	44,50	52,62	46,52	59,51	53,92	59,01	53,67	53,54	66,05
Menderes	13,82	27,28	43,53	42,71	25,71	53,25	51,99	27,07	44,80	32,77	56,67	56,94	57,75
Menemen	30,82	27,43	21,88	14,53	30,30	29,29	37,49	43,23	40,80	35,45	36,47	46,83	46,48
Narlidere	37,68	39,18	42,72	11,33	38,27	41,50	29,55	54,23	55,03	60,30	46,29	59,46	48,82
Odemis	27,79	23,57	33,77	33,03	38,15	35,77	38,02	41,63	54,13	55,33	50,68	52,26	56,92
Seferihisar	45,41	30,55	45,64	49,79	38,38	71,28	44,92	48,64	72,84	53,05	75,92	58,36	34,84
Selcuk	31,87	31,37	20,75	30,09	35,75	48,75	38,88	34,28	63,31	62,00	42,85	42,60	64,70
Tire	39,51	34,02	29,63	26,75	32,14	60,09	40,57	48,71	41,73	50,89	53,09	81,25	75,99
Torbali	30,40	31,86	37,35	16,52	31,88	40,46	44,45	43,75	36,81	38,21	44,50	33,88	44,35
Urla	42,33	61,47	52,40	32,51	51,80	97,51	47,02	60,98	54,66	64,68	74,03	80,93	72,83

Table 4.4. Age standardized incidence of the lung cancer in Izmir (1995-2007)

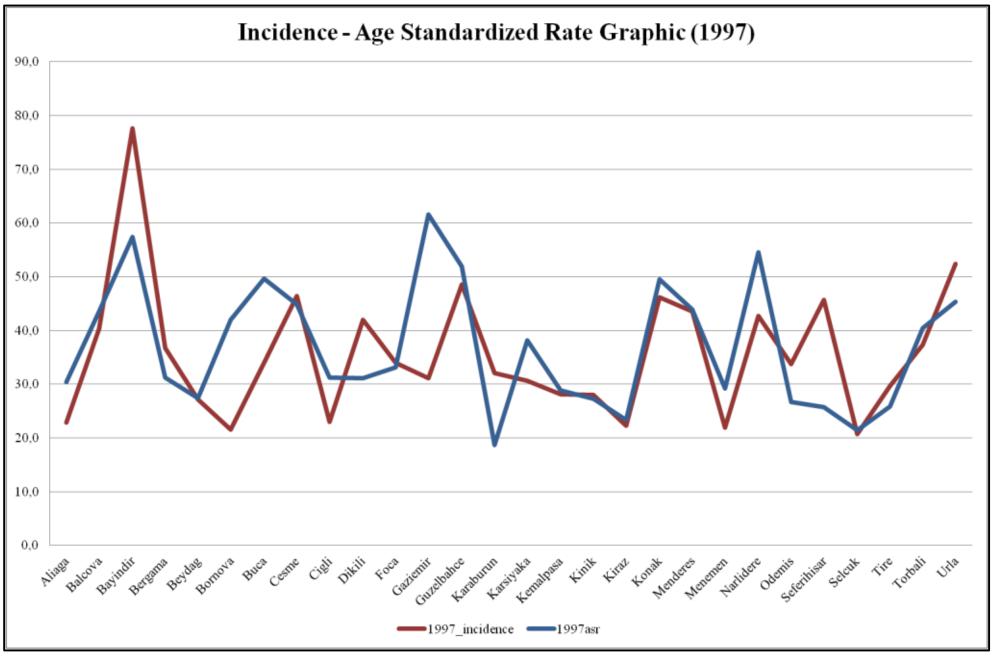
	1995asr	1996asr	1997asr	1998asr	1999asr	2000asr	2001asr	2002asr	2003asr	2004asr	2005asr	2006asr	2007asr
Aliaga	17,5	26	30,4	37,8	51,1	48,5	56,2	41	50,4	67,4	36	48,5	31,4
Balcova	37,7	44,9	43,6	37,2	36,5	42,2	45,1	46,1	42,8	39	38,6	48,5	53,5
Bayindir	32,6	43,1	57,4	39,1	30,3	64,5	60	43,1	40,3	34	64,5	40,5	47,2
Bergama	27,9	23,7	31,2	28,4	29,6	34,4	40,1	37,2	30	36,4	29,1	48,3	43,7
Beydag	26,2	4,8	27,4	18,4	6,6	18,8	44,9	25,1	12	23,7	36,7	13,1	34,7
Bornova	35,6	34,7	42	47	33,1	41,2	47,1	56,8	52,4	54,3	51,4	48	45,8
Buca	46,7	46,4	49,7	51,5	44,5	52,2	39,9	49,4	44,7	46,5	45,1	53,5	44,7
Cesme	29,4	49,9	44,9	74,4	55,7	78,2	51,5	31,1	44,7	74,3	56,3	64,5	50,2
Cigli	26,9	53,2	31,2	29,8	36,4	46,8	48,6	41,5	49,8	62,5	40,6	59,9	46,3
Dikili	29,9	31,7	31,1	34,7	22,8	65,6	56,9	23,8	40,2	36,8	53,5	27,3	29,8
Foca	26,3	12,3	33,1	58,7	53,4	37	62,9	15,3	51,7	64,3	42,8	31,8	35,3
Gaziemir	21,8	99,5	61,6	57,8	45	60	37,9	57	68,3	63,1	43,8	48,2	42,6
Guzelbahce	39,6	48,7	51,9	20,3	51,2	61,9	62,1	63,8	40,7	48,2	49,6	33,3	34,2
Karaburun	30,3	15,7	18,7	52,7	4,7	19,1	8,4	22,9	34,7	40,1	40,5	48,4	36,5
Karsiyaka	23,1	30,3	38,2	35	34,7	41,6	43,1	44	40,8	44,9	42,8	41,5	39,7
Kemalpasa	20,5	26,2	28,8	26,4	33,9	45,7	24,2	35,6	44,5	48,1	56,4	36,5	56,3
Kinik	30,8	42,1	27,3	50,9	17,5	55,7	59,8	39,5	45,6	29,4	31,2	56,2	33,8
Kiraz	11,4	19,8	23,3	18,1	11,9	19,7	25,1	22,4	15,9	36,6	36,6	29	20,1
Konak	37,5	38,5	49,5	42,2	46,1	52,8	46,1	52,4	50,8	52,2	46,4	43,6	54,3
Menderes	17,2	32,1	43,9	46,6	29,3	50,8	50,5	35,6	40,2	33,6	53,5	47,8	44,1
Menemen	40	35,8	29,2	21,5	38,7	36	53,2	56,5	55,2	44	42,9	47,6	46,2
Narlidere	59,3	57	54,5	15,3	43,4	43,6	38,4	44,7	52,5	64,4	42,8	51,1	42,8
Odemis	22,8	19,7	26,7	26,5	30,3	26,6	28,5	31	39,6	39,8	34,2	35,7	37,3
Seferihisar	30	39,9	25,8	40	44,2	31,2	66,9	44,2	43,7	52,9	46,4	49,1	34,8
Selcuk	7,3	33,8	21,4	29,3	35,2	46,5	39,2	30,5	52,2	55,8	35,2	30,9	52,5
Tire	31,3	28,9	25,9	22,5	24,2	44	30,7	34	34	37,5	36,5	53,3	40,4
Torbali	30,6	35,7	40,4	18	32,9	38,4	41,8	47,3	40,6	39,8	44,4	31,6	43,2
Urla	43,4	59,2	45,3	38,3	49,6	75	39,4	44,8	40,4	52,3	47,9	50,1	49,4



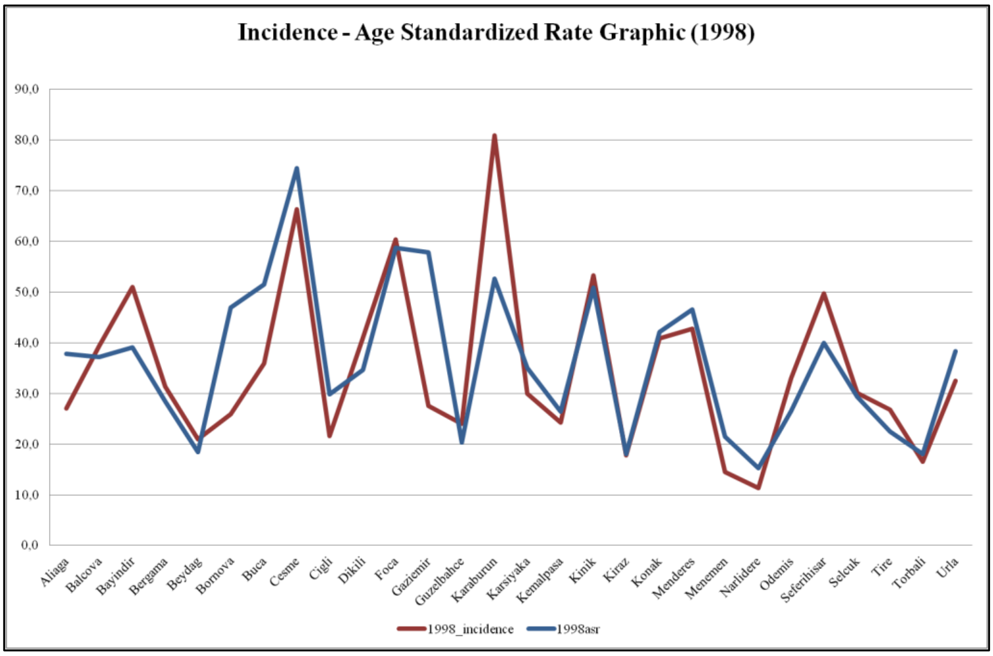
Graph 4.1. Crude incidence and ASR incidence of Izmir graphic - 1995



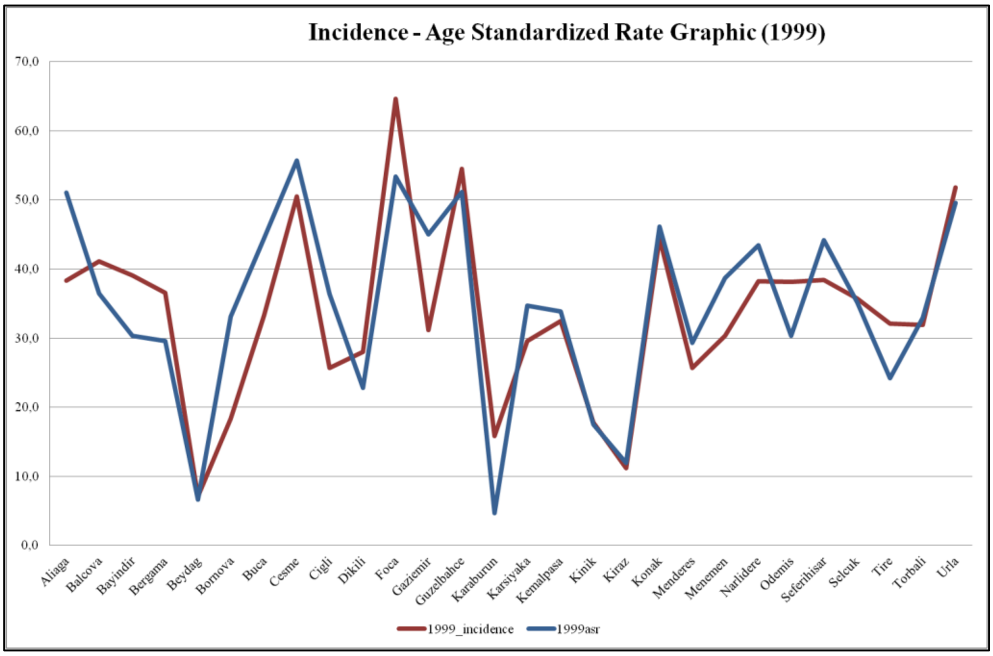
Graph 4.2. Crude incidence and ASR incidence of Izmir graphic - 1996



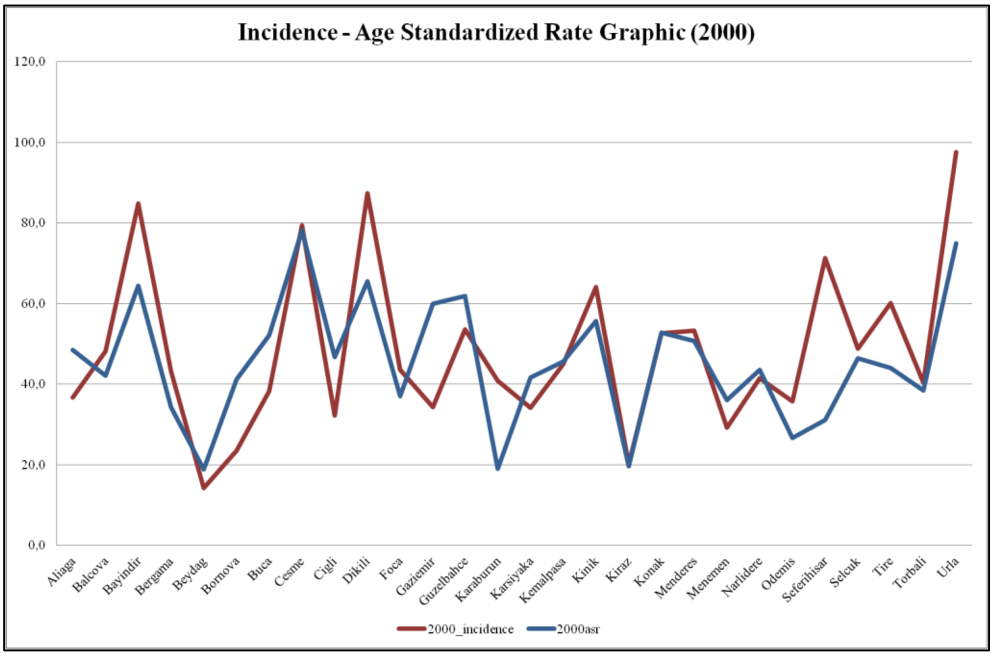
Graph 4.3.Crude incidence and ASR incidence of Izmir graphic - 1997



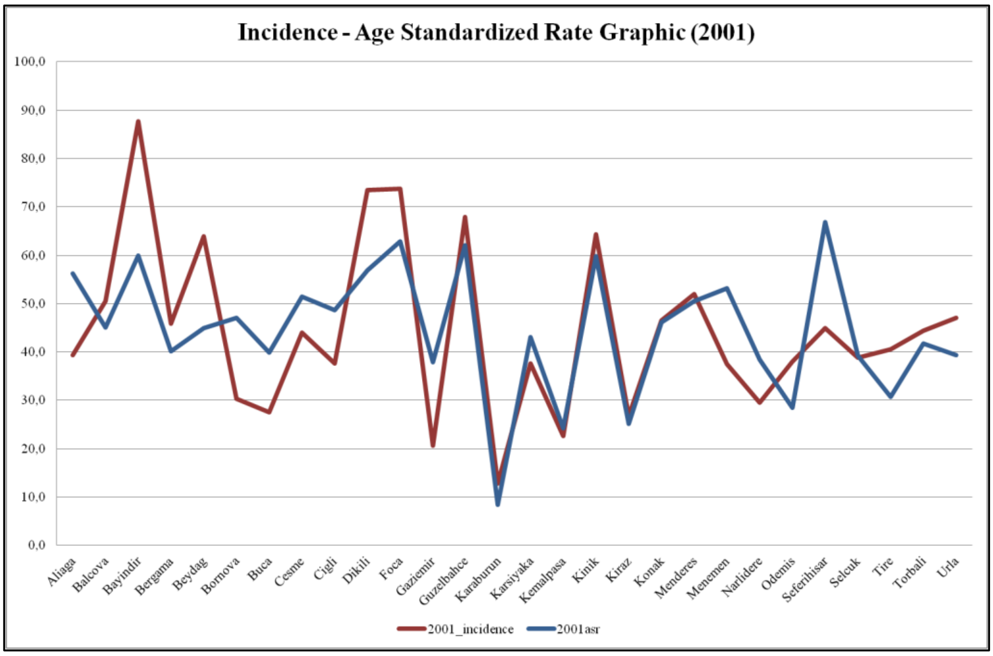
Graph 4.4. Crude incidence and ASR incidence of Izmir graphic - 1998



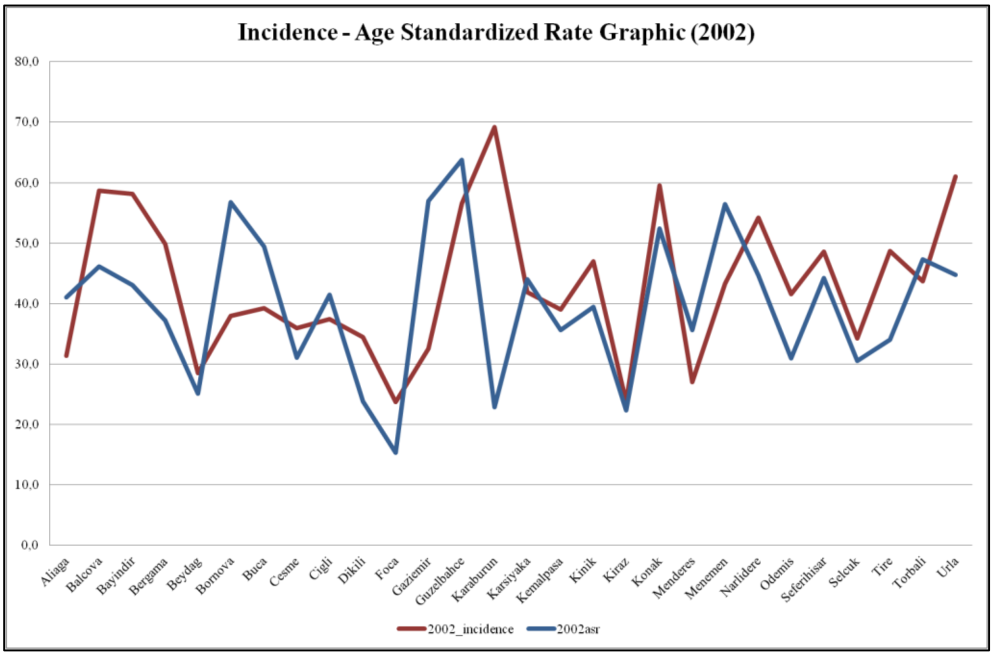
Graph 4.5. Crude incidence and ASR incidence of Izmir graphic - 1999



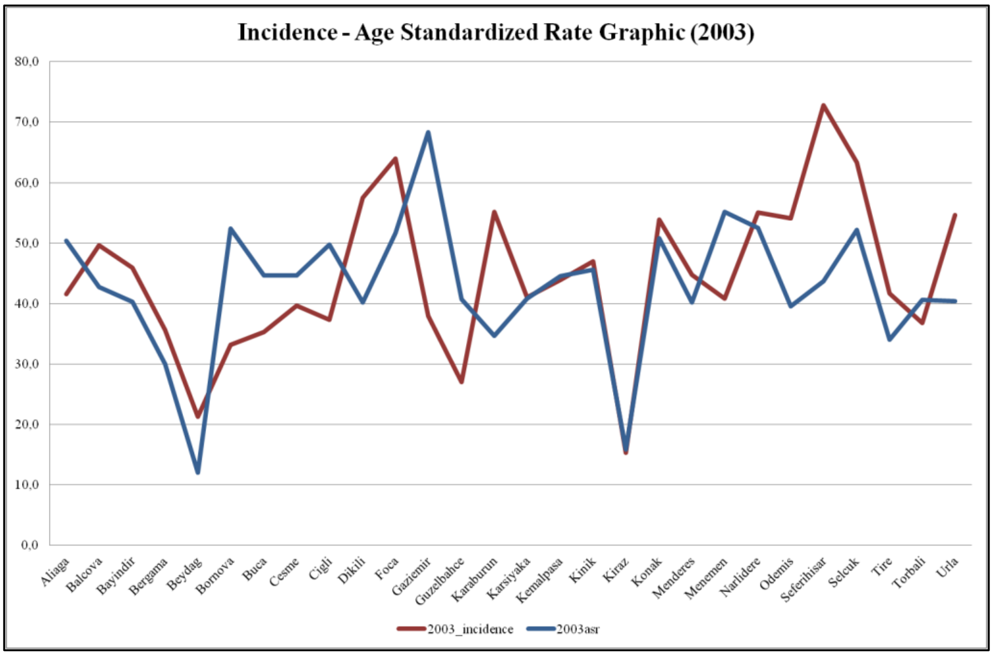
Graph 4.6. Crude incidence and ASR incidence of Izmir graphic - 2000



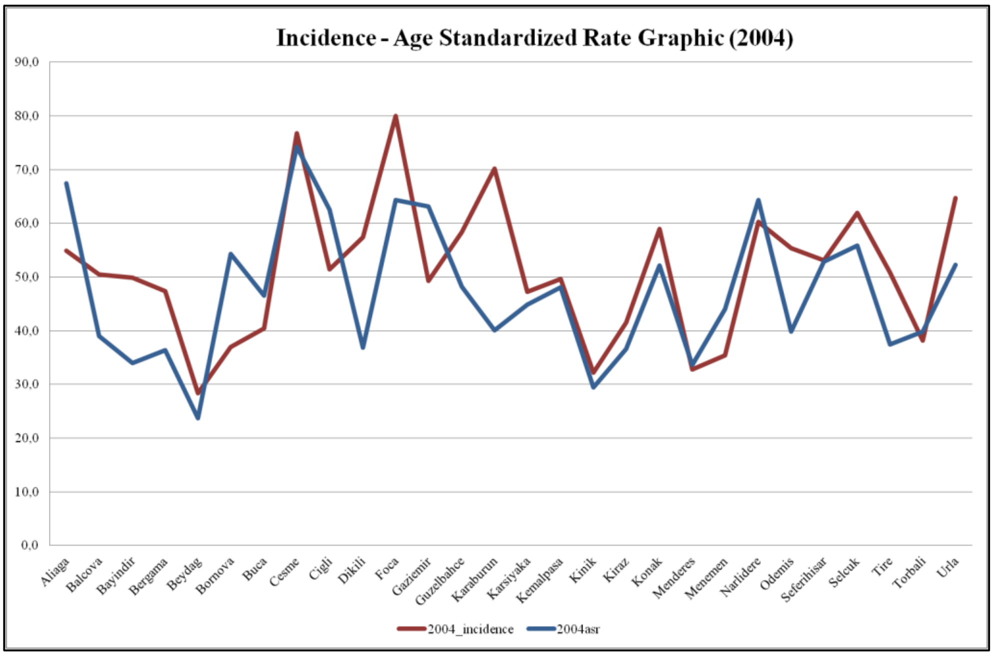
Graph 4.7. Crude incidence and ASR incidence of Izmir graphic - 2001



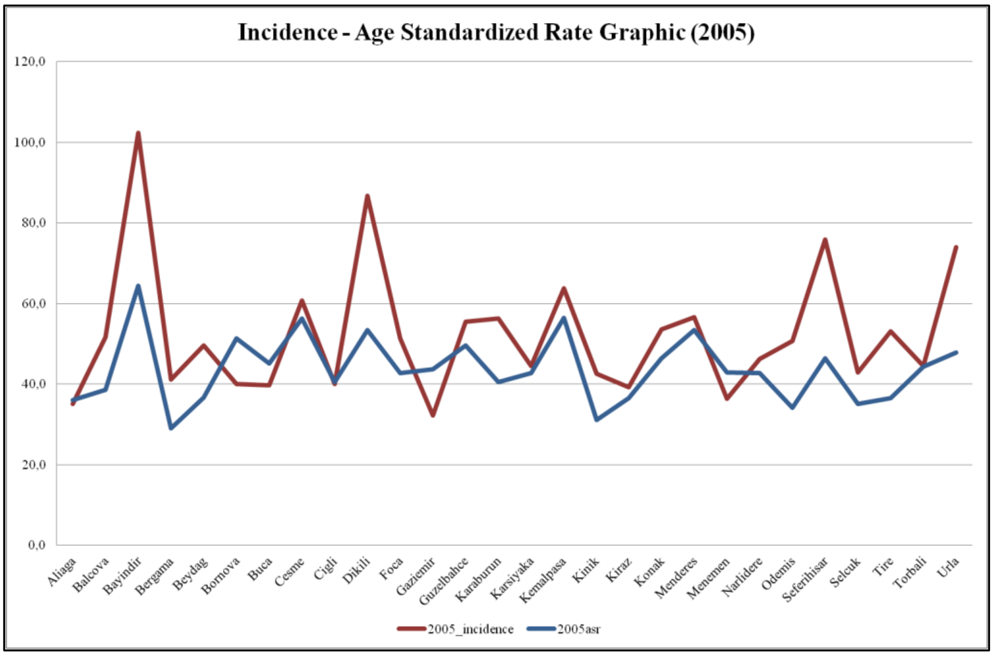
Graph 4.8. Crude incidence and ASR incidence of Izmir graphic - 2002



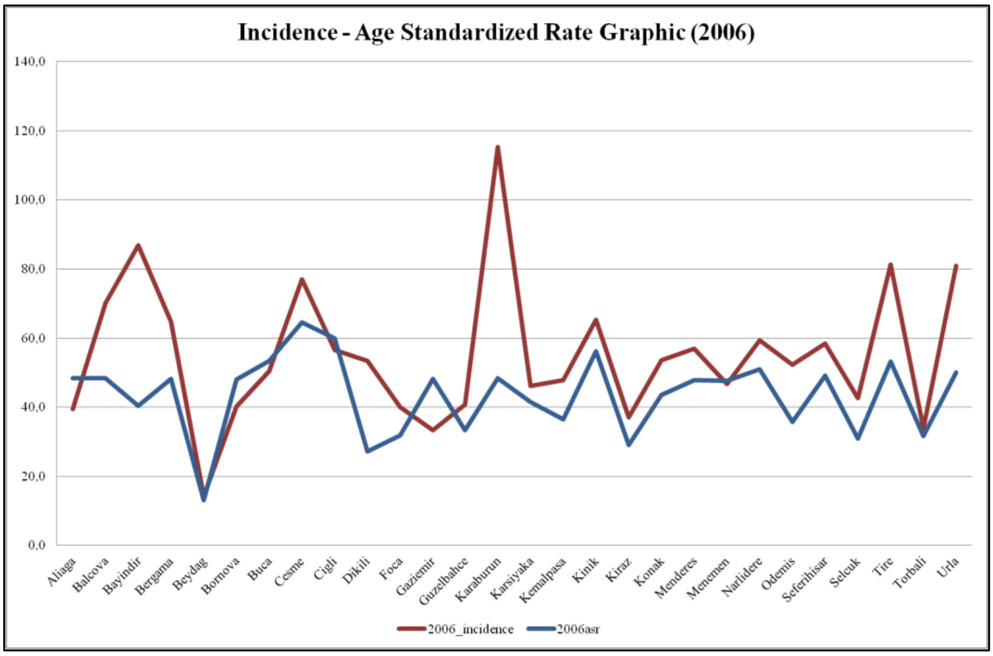
Graph 4.9. Crude incidence and ASR incidence of Izmir graphic - 2003



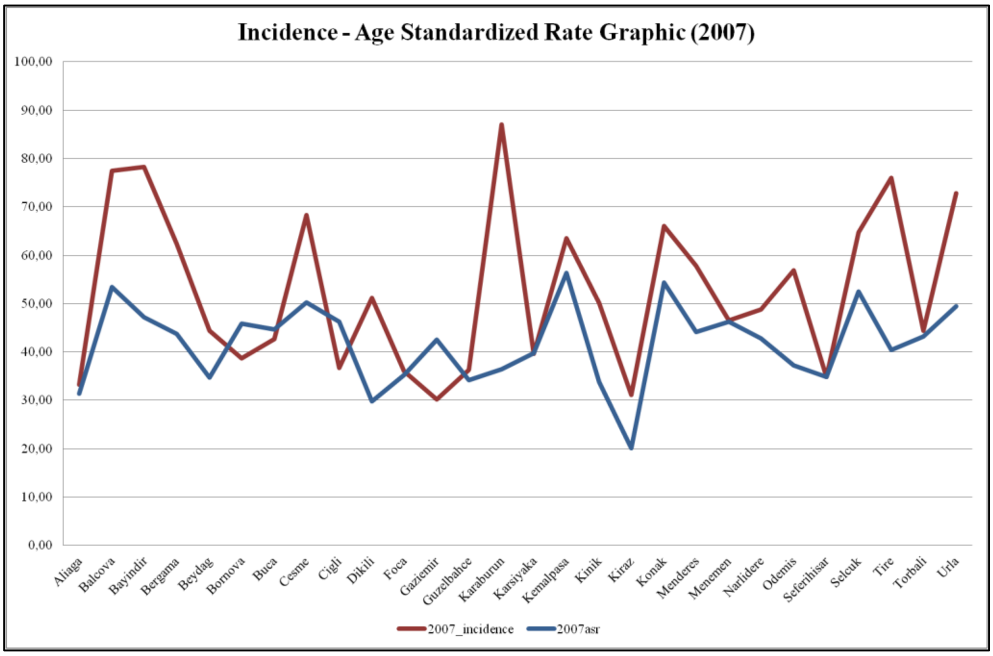
Graph 4.10. Crude incidence and ASR incidence of Izmir graphic - 2004



Graph 4.11. Crude incidence and ASR incidence of Izmir graphic - 2005



Graph 4.12. Crude incidence and ASR incidence of Izmir graphic - 2006



Graph 4.13. Crude incidence and ASR incidence of Izmir graphic - 2007

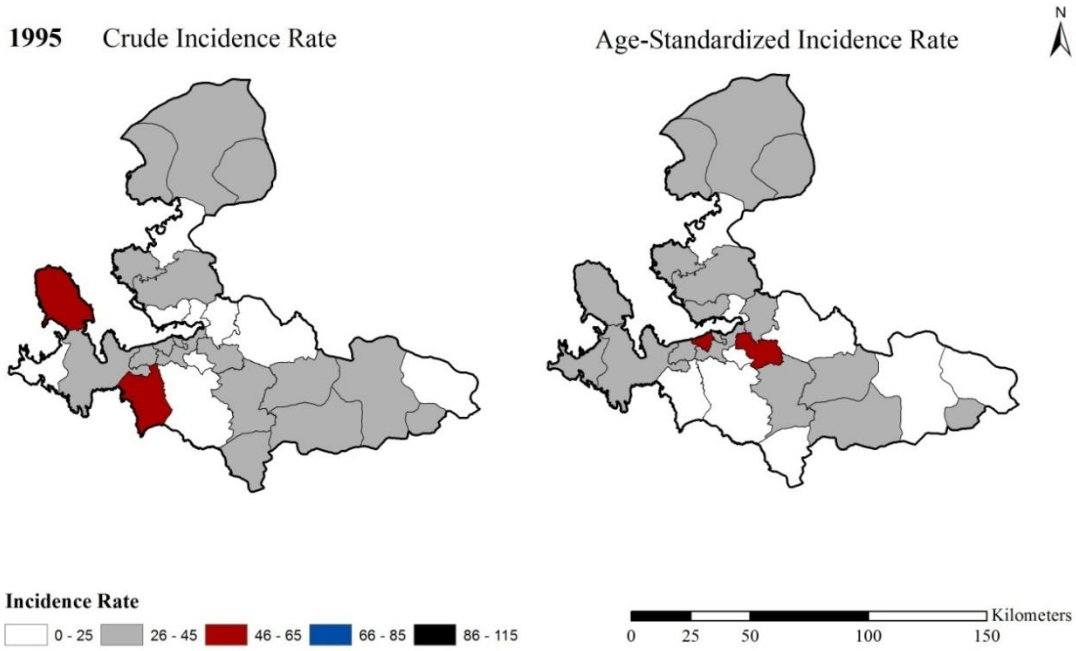


Figure 4.4. Crude incidence and ASR incidence thematic maps of Izmir – 1995

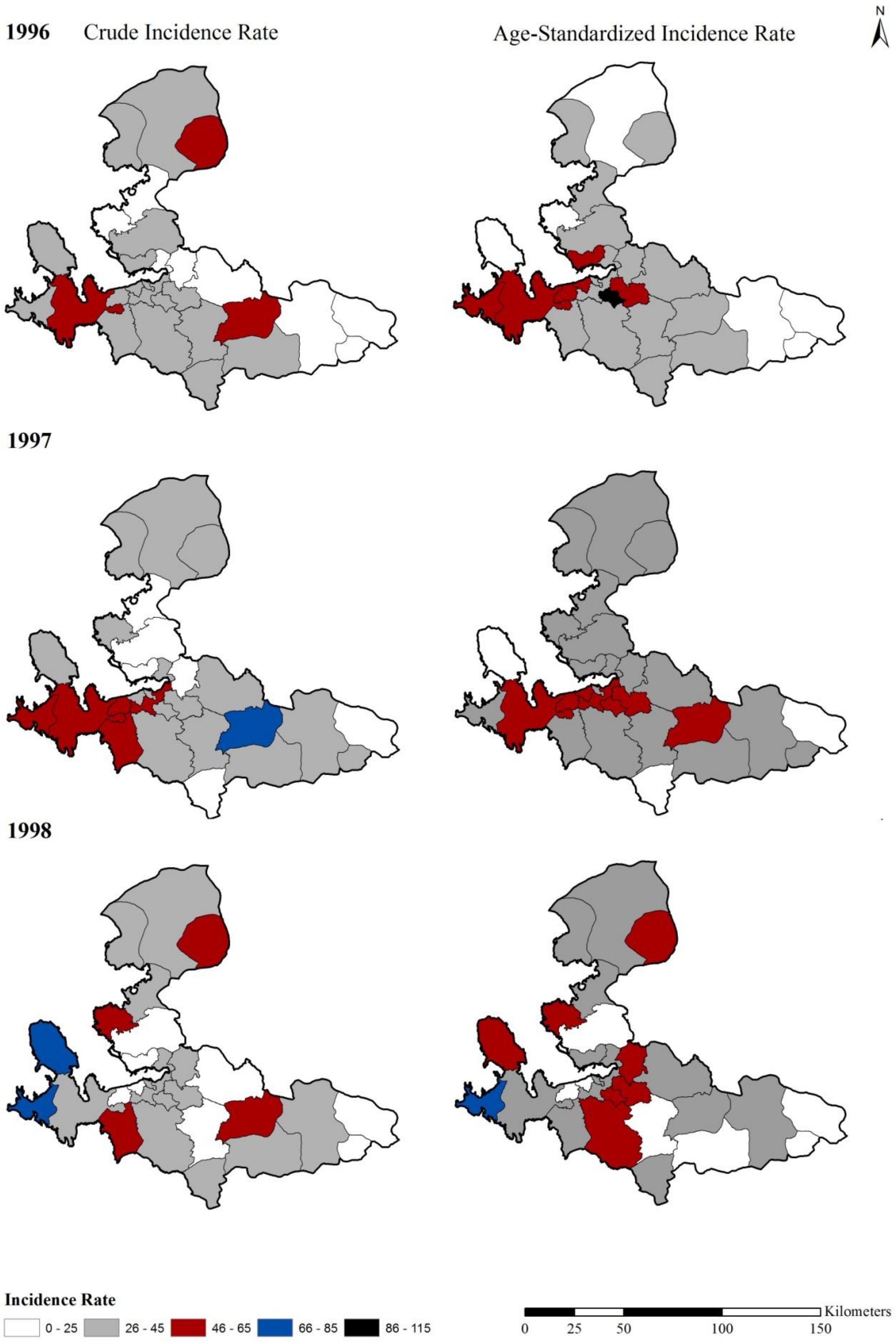


Figure 4.5. Crude incidence and ASR incidence thematic maps of Izmir – 1996-1998

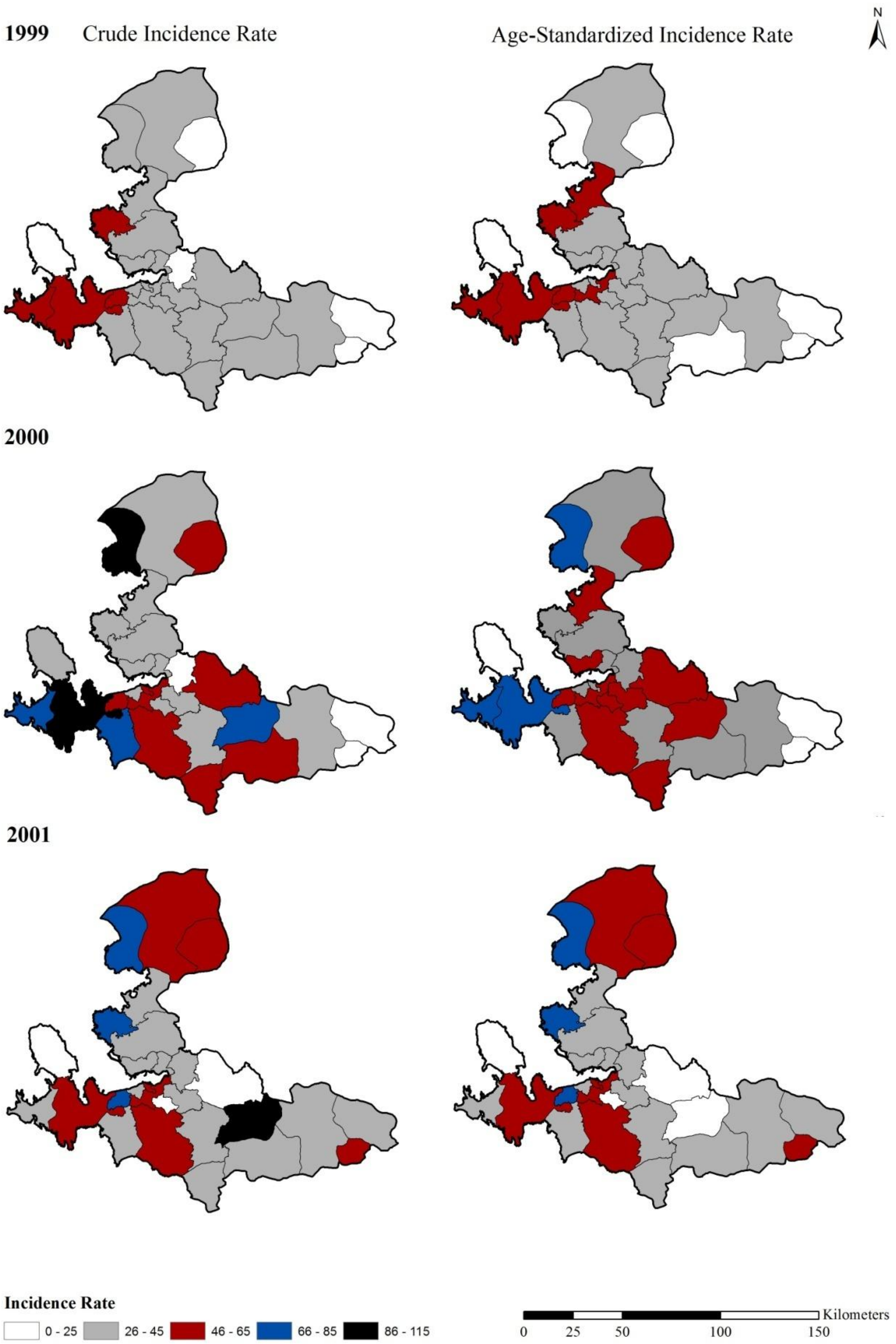


Figure 4.6. Crude incidence and ASR incidence thematic maps of Izmir – 1999-2001

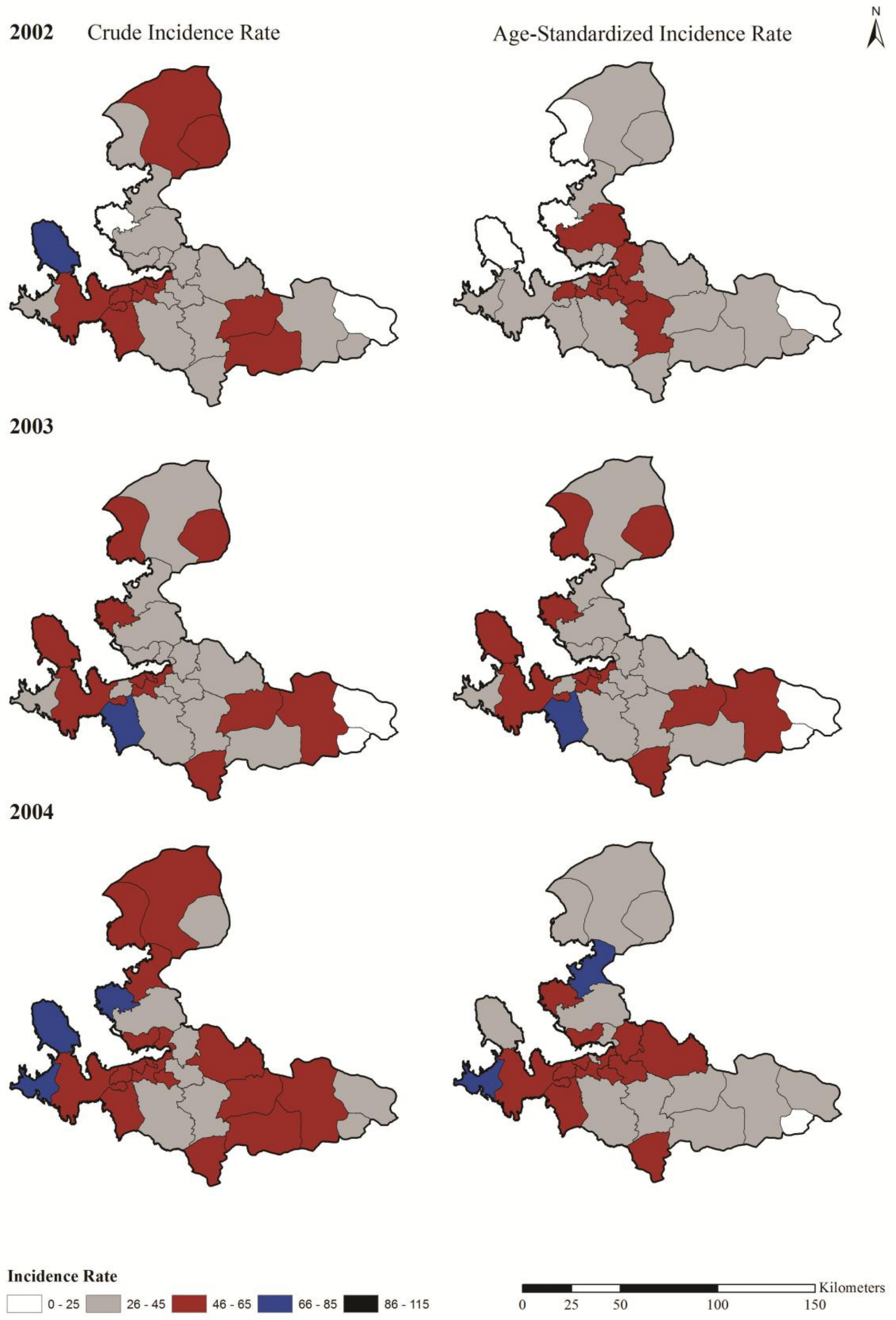


Figure 4.7. Crude incidence and ASR incidence thematic maps of Izmir – 2002-2004

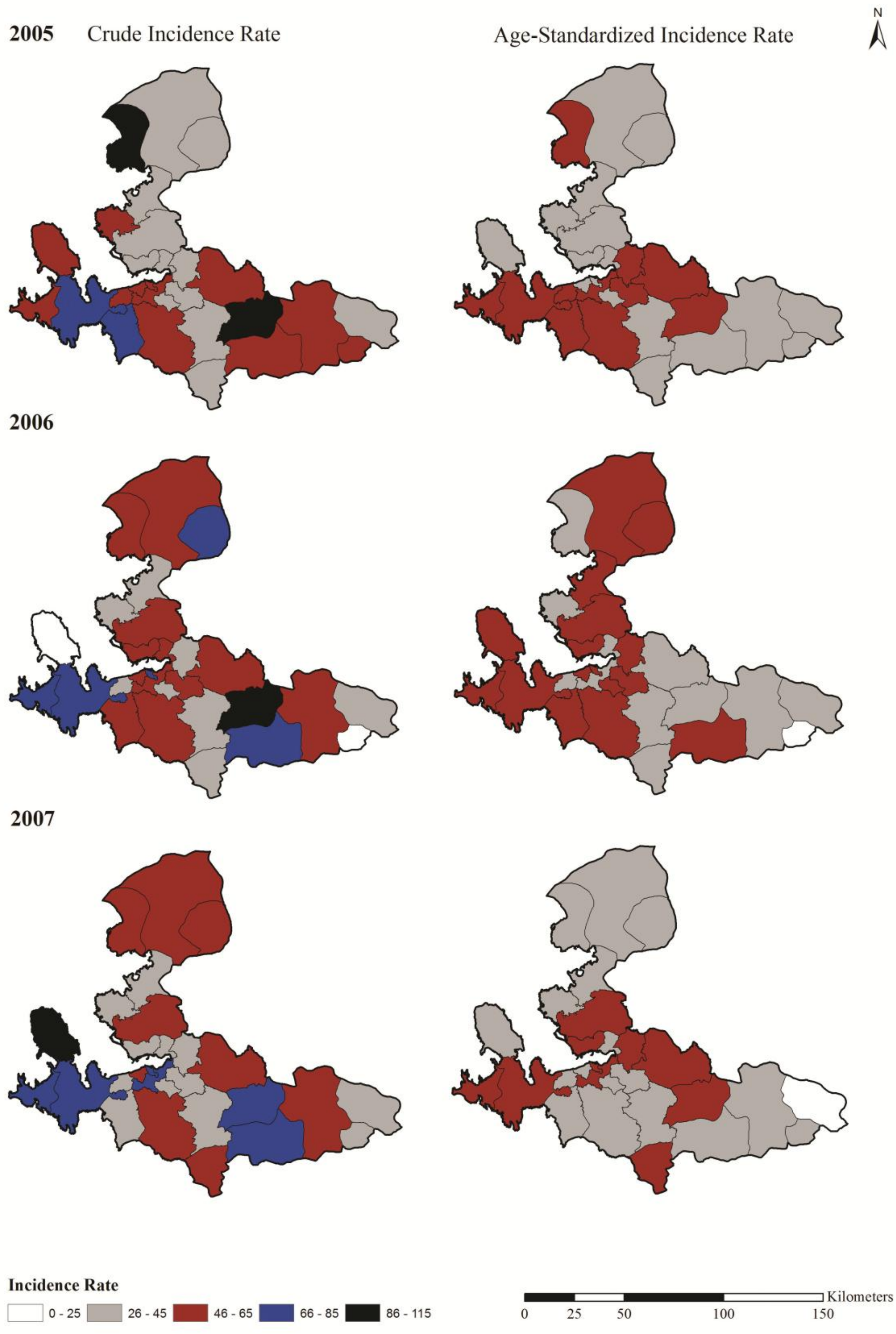


Figure 4.8. Crude incidence and ASR incidence thematic maps of Izmir – 2005-2007

4.2. Statistical information about districts

In this section, statistical information is given for Cesme, Gaziemir, Konak and Urla Districts. These four districts have the highest ASR incidence among Izmir Districts. Figures include the district' administrative borders, main roads and the location of cases. Tables show district's population, number of cancer cases and ASR incidence rates. Additionaly, graphs represent the respective tabular information. The other districts are given in alphabetical order in Appendix A.

4.2.1. Cesme

In the case of Cesme, in (Figure 4.9, Table 4.5 and Graph 4.14), cancer case, incidence and population change curve is seen. As seen in population curve of Cesme, while totally 90% increase is seen on population, 70% increase is seen on incidence rate from 1995 to 2007. Incidence rate curve has many sharp increasing and decreasing periods by the changing value of population and cases. The highest increase amounts on incidence rate that one of these is almost 69% to 1996 and it's value is 50 and the other is 66% to 2004 with the value of 74.3. However, incidence rate has lowest value on 1995 with the value of 29 and on 2002 with the value of 31.

Table 4.5. Cesme population – case and ASR incidence

	Cesme_population	Cesme_cancer_case	Cesme_asr_incidence
1995	14616	2	29,4
1996	15320	6	49,9
1997	15096	7	44,9
1998	15064	10	74,4
1999	15847	8	55,7
2000	17629	14	78,2
2001	18186	8	51,5
2002	19466	7	31,1
2003	20186	8	44,7
2004	20851	16	74,3
2005	21370	13	56,3
2006	22084	17	64,5
2007	27796	19	50,2

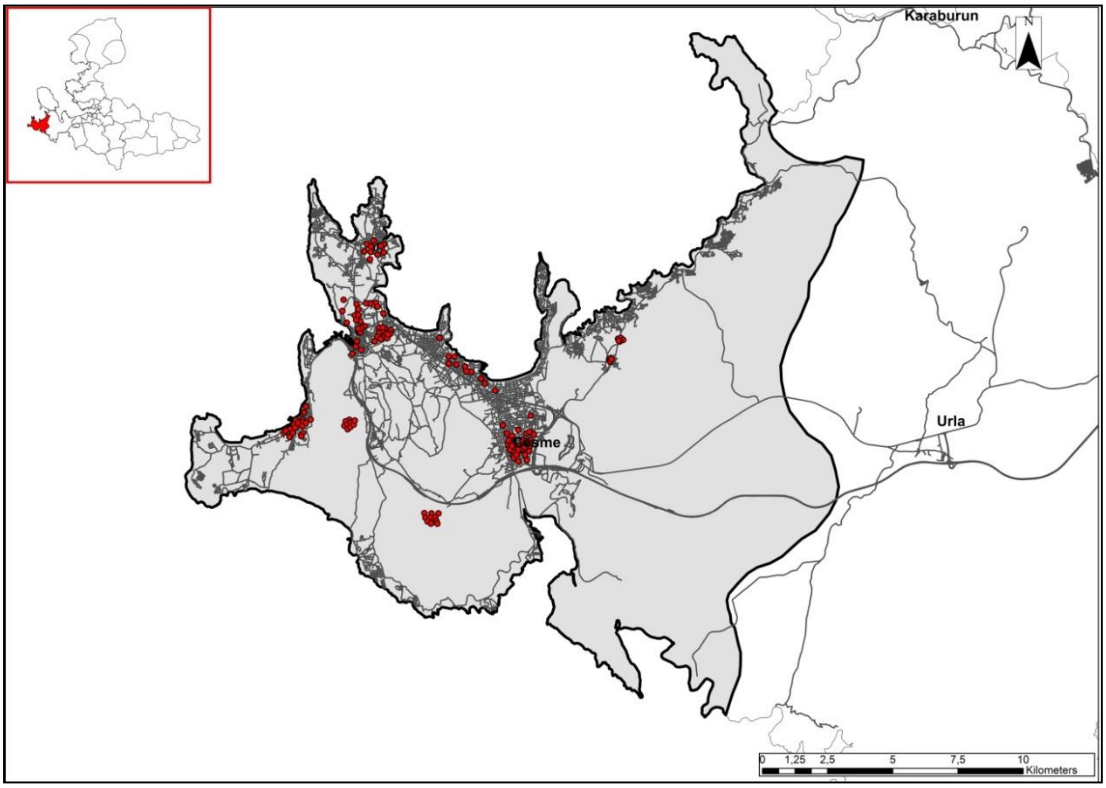
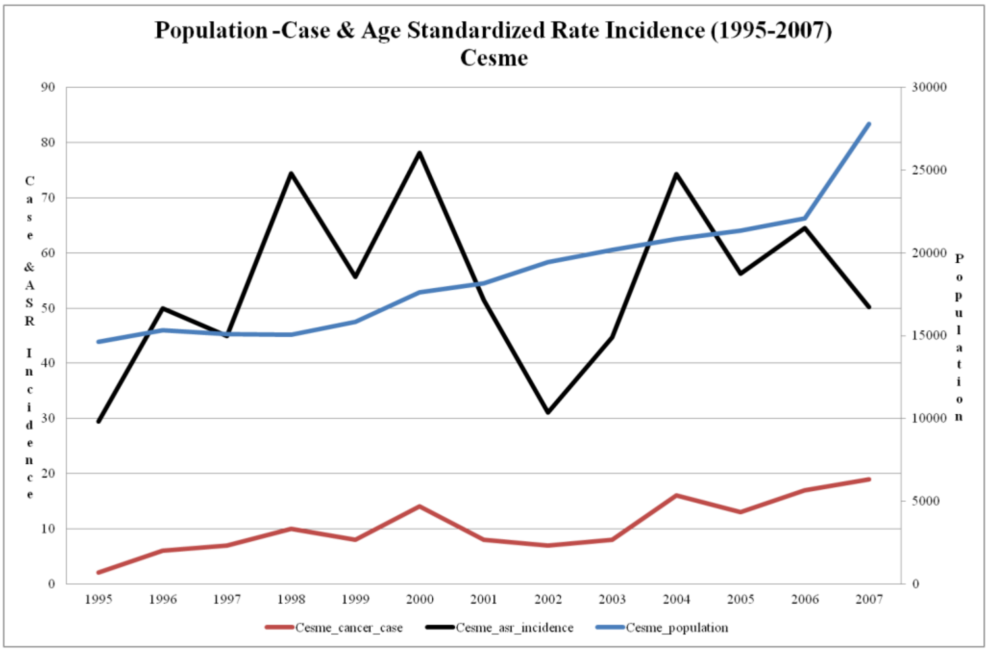


Figure 4.9. Cesme



Graph 4.14. Cesme population – case and ASR incidence graphic (1995-2007)

4.2.2. Gaziemir

In the case of Gaziemir, in (Figure 4.10, Table 4.6 and Graph 4.15), cancer case, incidence and population change curve is seen. As seen in population curve of Gaziemir, it shows continuous increasing trend and while totally 88% increase is seen on population, 95% increase is seen on incidence rate between 1995 and 2007. Incidence rate shows almost same trends with cancer case curve and also it has many sharp increasing and decreasing periods by the changing value of population and cases. The highest increase rate on incidence rate that one of these is almost 356% to 1996 and it's value is 99 and the other is 50% to 2002 with the value of 57. Incidence rate has lowest value in 1995 with the value of 21 and highest value in 1996 with the value of 99.

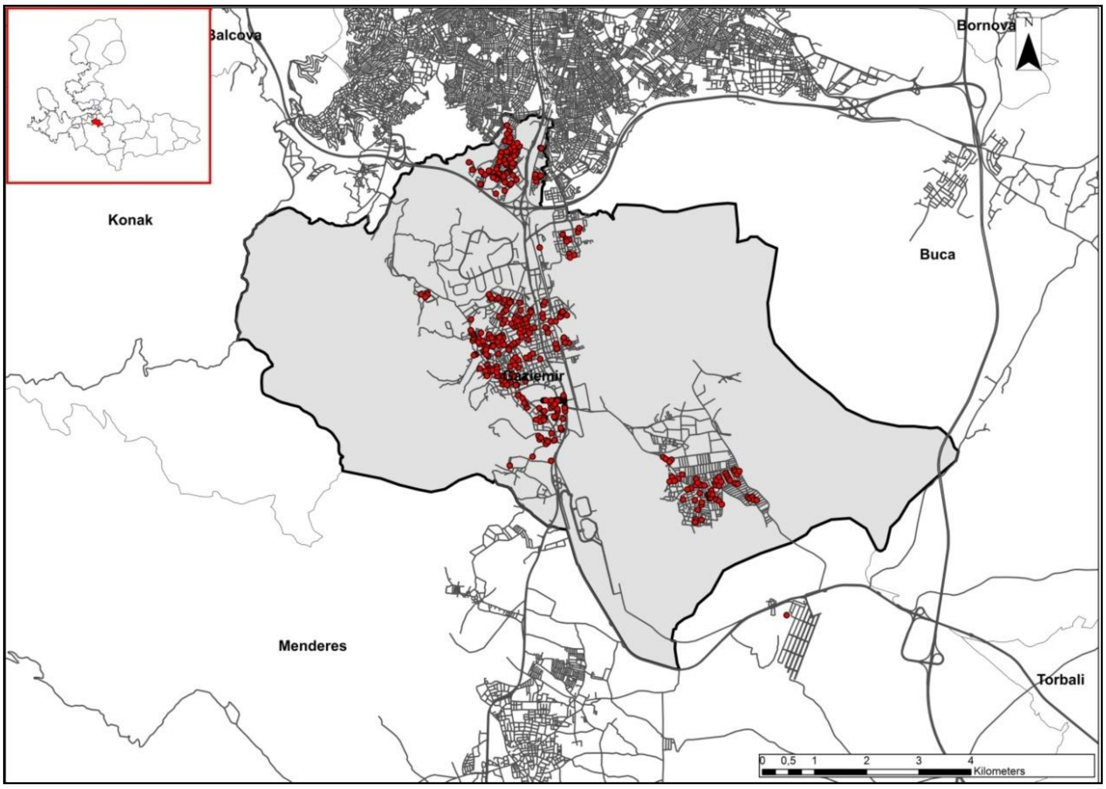
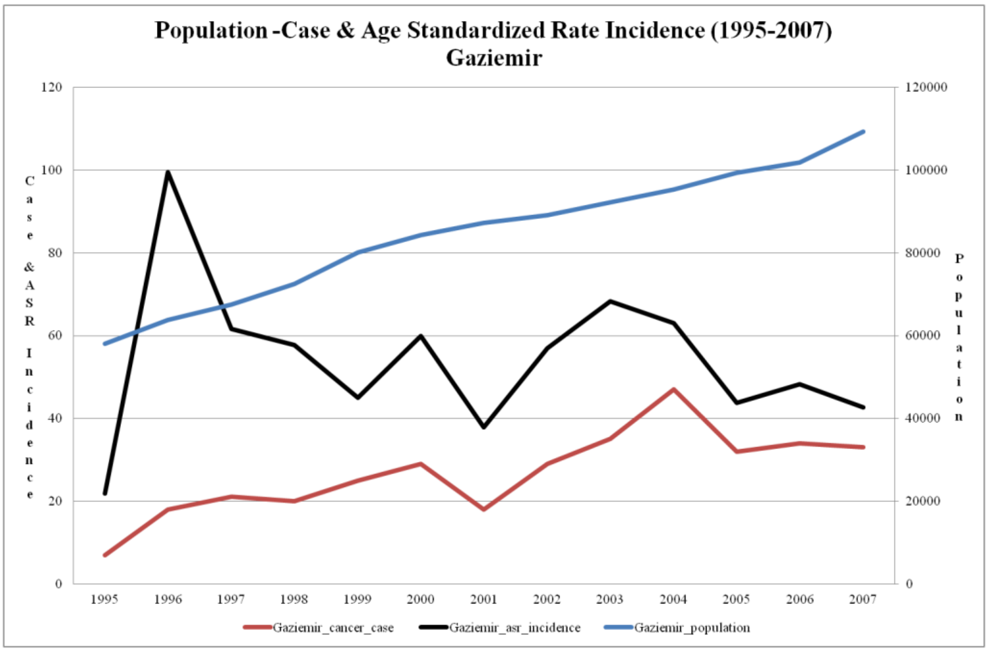


Figure 4.10. Gaziemir

Table 4.6. Gaziemir population – case and ASR incidence

	Gaziemir_population	Gaziemir_cancer_case	Gaziemir_asr_incidence
1995	58036	7	21,8
1996	63818	18	99,5
1997	67553	21	61,6
1998	72444	20	57,8
1999	80191	25	45
2000	84326	29	60
2001	87223	18	37,9
2002	89203	29	57
2003	92282	35	68,3
2004	95395	47	63,1
2005	99367	32	43,8
2006	101843	34	48,2
2007	109291	33	42,6



Graph 4.15. Gaziemir population – case and ASR incidence graphic (1995-2007)

4.2.3. Konak

In the case of Konak, in (Figures 4.11 and 4.12, Table 4.7 and Graph 4.16), cancer case, incidence and population change curve is observed. As observed in population curve although there are decreasing periods, population and case curve show almost continuous increasing trend. While totally 10% increase is observed on population, 45% increase is observed on incidence rate from 1995 to 2007. Incidence rate has many sharp increasing and decreasing periods despite the smooth changes in the population and case. The highest increase rate on incidence rate is almost 28% in 1997 and it's value is 50. Incidence rate has the lowest value in 1995 with the value of 37.5 and highest value in 2007 with the value of 54.

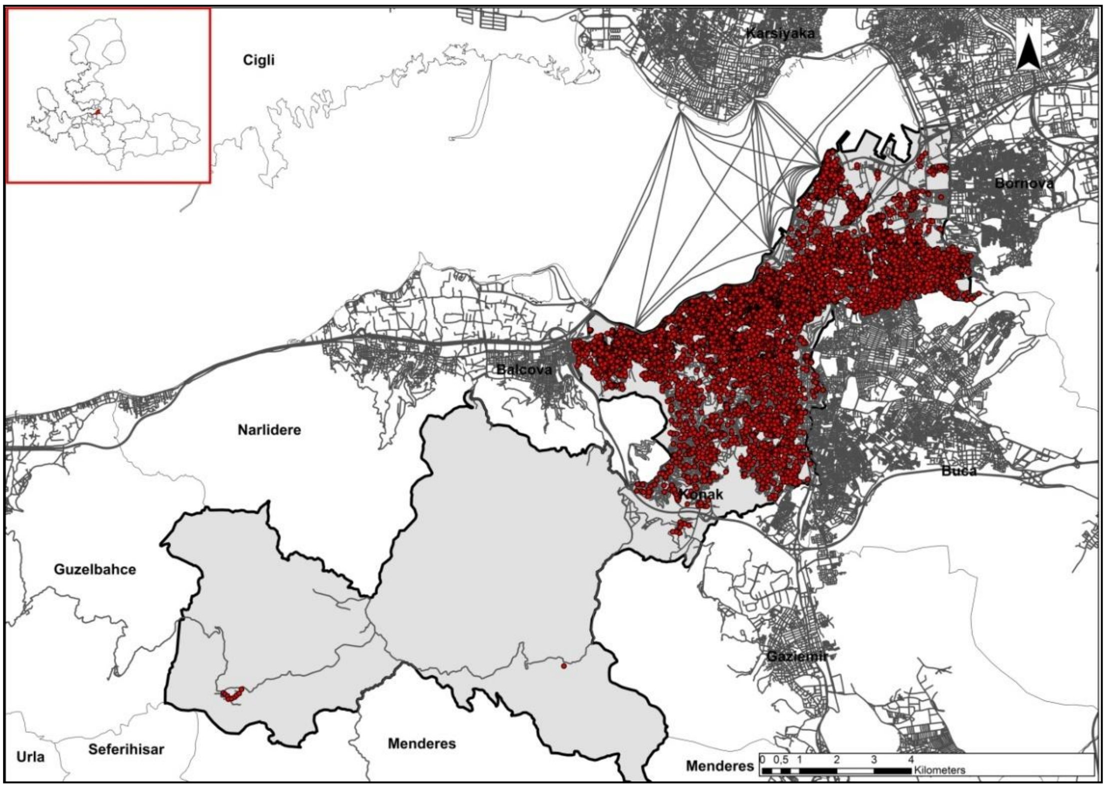


Figure 4.11. Konak

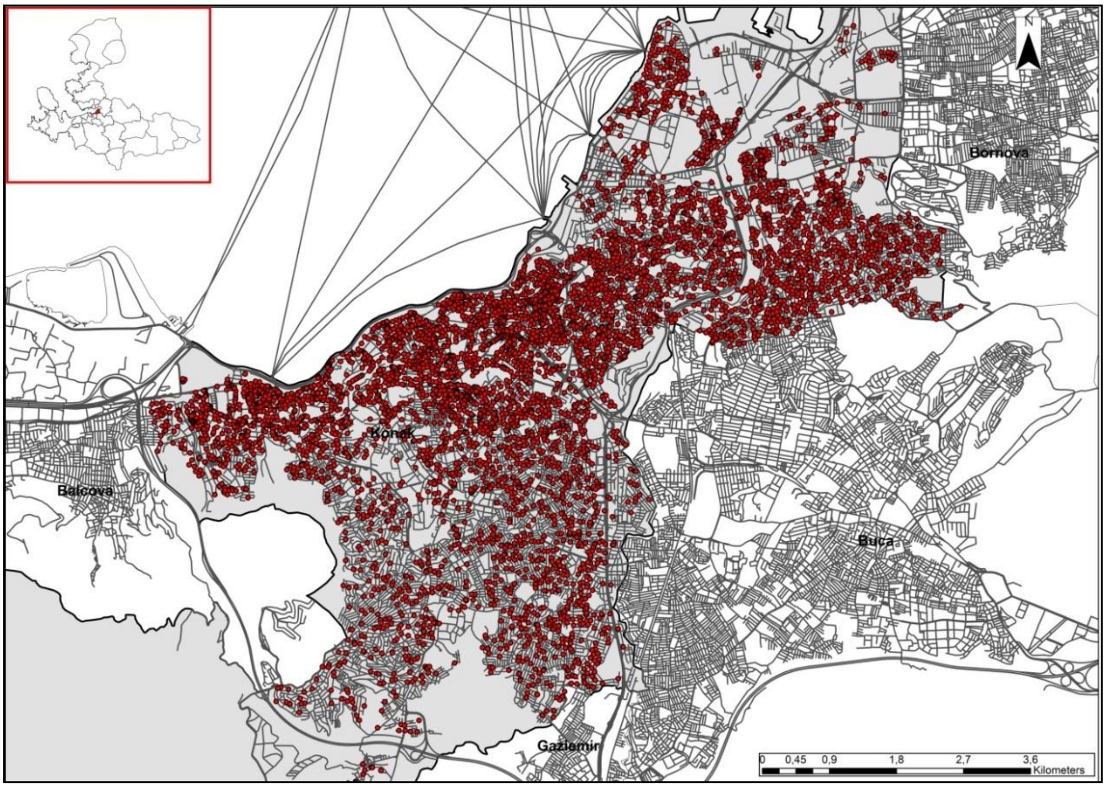
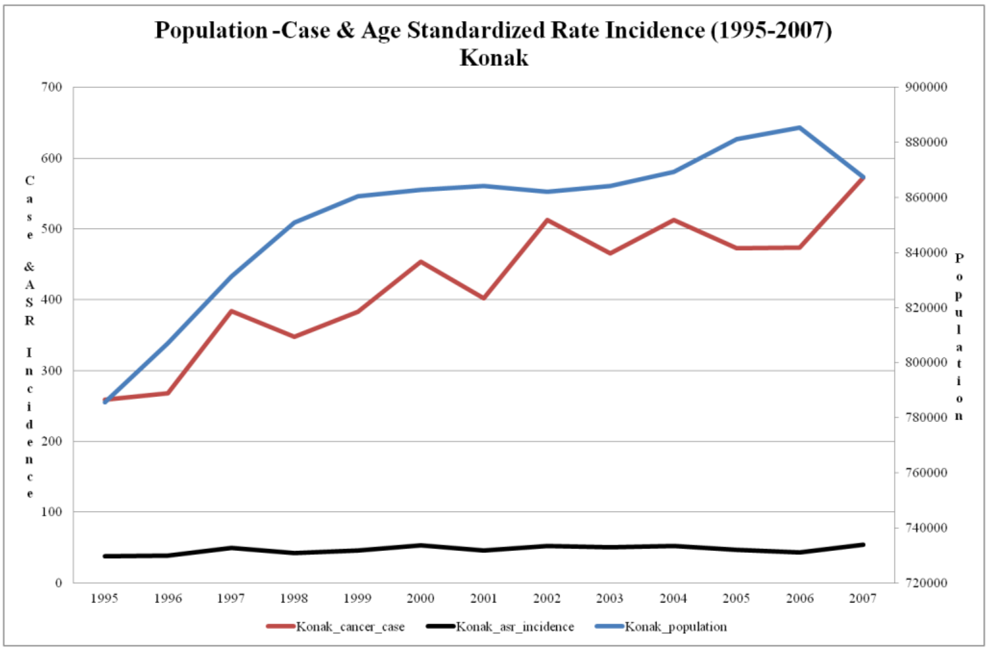


Figure 4.12. Konak in detail

Table 4.7. Konak population – case and ASR incidence

	Konak_population	Konak_cancer_case	Konak_asr_incidence
1995	785687	259	37,5
1996	807200	268	38,5
1997	831233	384	49,5
1998	850918	348	42,2
1999	860579	383	46,1
2000	862805	454	52,8
2001	864175	402	46,1
2002	862042	513	52,4
2003	864170	466	50,8
2004	869394	513	52,2
2005	881235	473	46,4
2006	885399	474	43,6
2007	867481	573	54,3



Graph 4.16. Konak population – case and ASR incidence graphic (1995-2007)

4.2.4. Urla

In the case of Urla, in (Figure 4.13, Table 4.8 and Graph 4.17), cancer case, incidence and population change curve is observed. As observed in population curve, it shows steady increase trend. Totally 69% increase is observed on population and 13% increase is observed on incidence rate from 1995 to 2007. Incidence rate shows almost same trends with cancer case curve and also it has many sharp increasing and decreasing periods by the changing value of population and cases. The highest increase rate on incidence rate that one of these is almost 51% in 2000 and it's value reaches to 75 and the other is 30% in 1999 with the value of 50. Incidence rate has the lowest value in 1998 with the value of 38 and the highest value in 2000 with the value of 75.

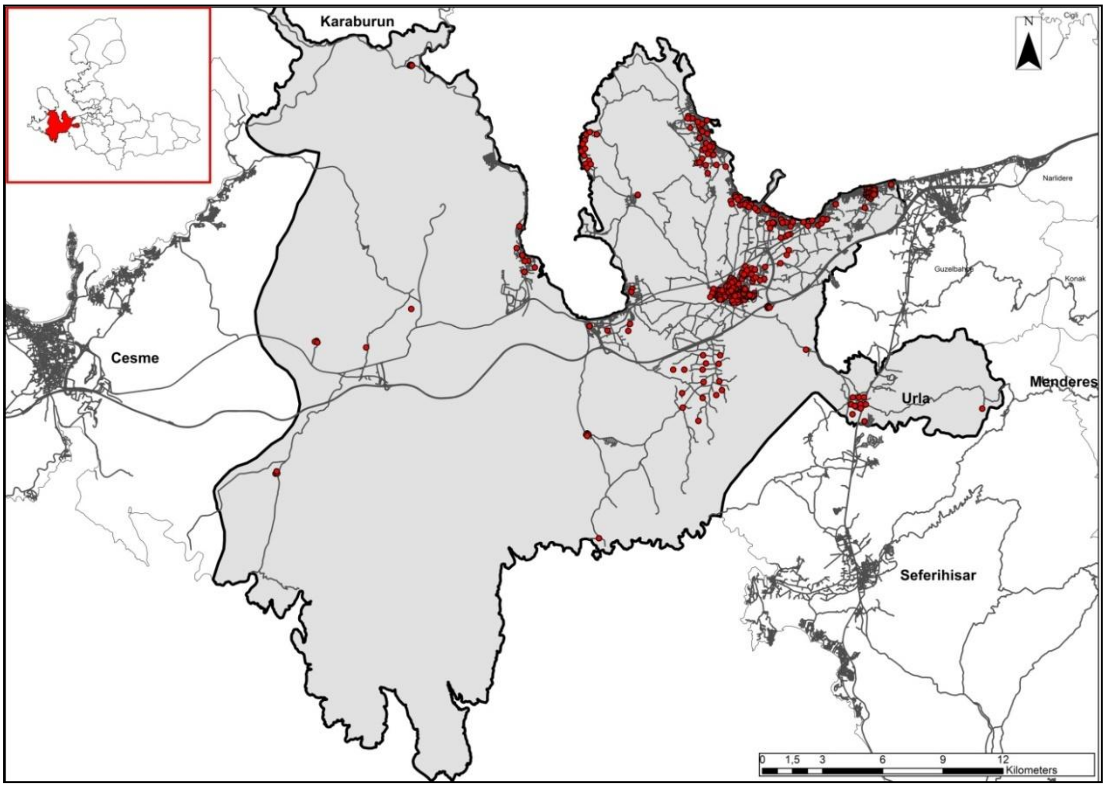
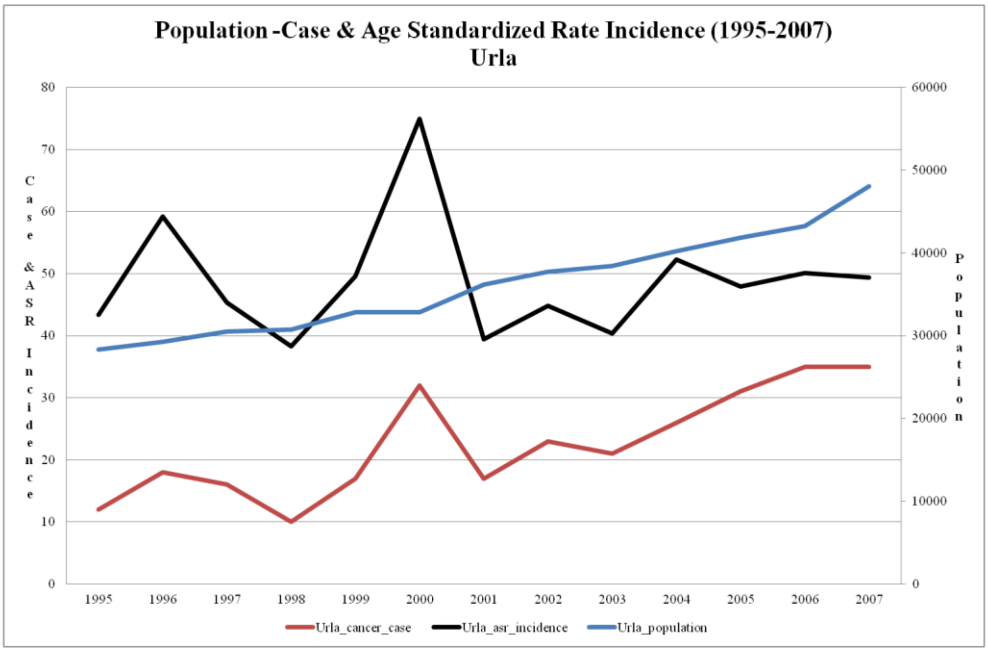


Figure 4.13. Urla

Table 4.8. Urla population – case and ASR incidence

	Urla_population	Urla_cancer_case	Urla_asr_incidence
1995	28346	12	43,4
1996	29284	18	59,2
1997	30533	16	45,3
1998	30757	10	38,3
1999	32818	17	49,6
2000	32818	32	75
2001	36153	17	39,4
2002	37716	23	44,8
2003	38420	21	40,4
2004	40197	26	52,3
2005	41877	31	47,9
2006	43248	35	50,1
2007	48058	35	49,4



Graph 4.17. Urla population – case and ASR incidence graphic (1995-2007)

4.3. Spatial Autocorrelation of Lung Cancer Cases

Spatial autocorrelation is measured based on feature locations of cancer cases and feature values of incidence rate of neighborhoods in order to find out whether the point pattern is clustered, dispersed or random by the Spatial Autocorrelation (Morans I) tool. The Moran's I Index value, a Z score, p-value evaluating the significance of the index is calculated for 2000 and 2007 of neighborhoods incidence rates.

In the case of the neighborhood distribution of cancer cases, the null hypothesis states that there is no spatial clustering of the case values associated with the geographic features in the study area. Since the p-value is small, the absolute value of the standard deviation (Z score) is large that it falls outside of the confidence level and the index value is larger than 0 for both values of two years, it is unlikely that the observed spatial pattern of cancer cases is the result of random processes, so the null hypothesis is rejected with a confidence level of 99 as observed in the graphs.

Since the Global Moran’s I is an inferential statistics, the positive Moran’s Index is interpreted that the values of incidence rates in the dataset is clustered spatially and also it refers that high values cluster near other high values within the context of the incidence rate of each neighborhood units. The same trend is almost observed in both incidence rate values of 2000 and 2007 calculated according to the case numbers and address-based population census of neighborhoods in each year.

In order to map the clusters, the Getis-Ord Gi* statistic, that produces an output map, is calculated for each feature of neighborhoods in the dataset by the hot spot tool. This tool also calculated thez-scores and p-valuesby looking at each feature within the context of neighboring features for mapping where features with either high or low values cluster spatially. Since the tool calculates statistically significant positive z-scores, the larger the z-score shows the hot spot that means the more intense clustering of high values. A high z-score and small p-value for a feature indicates whether high values cluster with another high values spatially within the context of incidence rate dataset as shown in Figure 4.14of 2000 and Figure 4.15 of 2007.

According to the z scores and p value of hot spot analysis, in figures 4.15 and 4.16, the red labeled features represent hotspots neighborhoods with larger z score than +2.58 and smaller p value than 0.01 that leads to the confidence level of 99. While the blue labeled ones represent cold spot neighborhood with negative and larger z score than -1.96 and smaller p value than 0.10 with the confidence level of 95. The yellow labeled features representing the z score between -1.65 and +1.65 values are defined as expected outcome of random pattern.

According to the incidence rate pattern map of 2000, 93 of 323 neighborhoods, 94% of them are within the Konak district and 6% of them are within the Buca district, are detected as hotspots and they cluster as observed in Figure 4.16. The same trend is observed in 2007, the hotspots are occurred in the same place, but this time it is expanded. 121 of 353 neighborhoods, 92% of them are within the Konak districts and 8% of them are within the Buca district, are detected as hotspots and they cluster as observed in Figure 4.17. The rest of the neighborhood units do not generate a hot or cold spots in terms of their feature locations and incidence values.

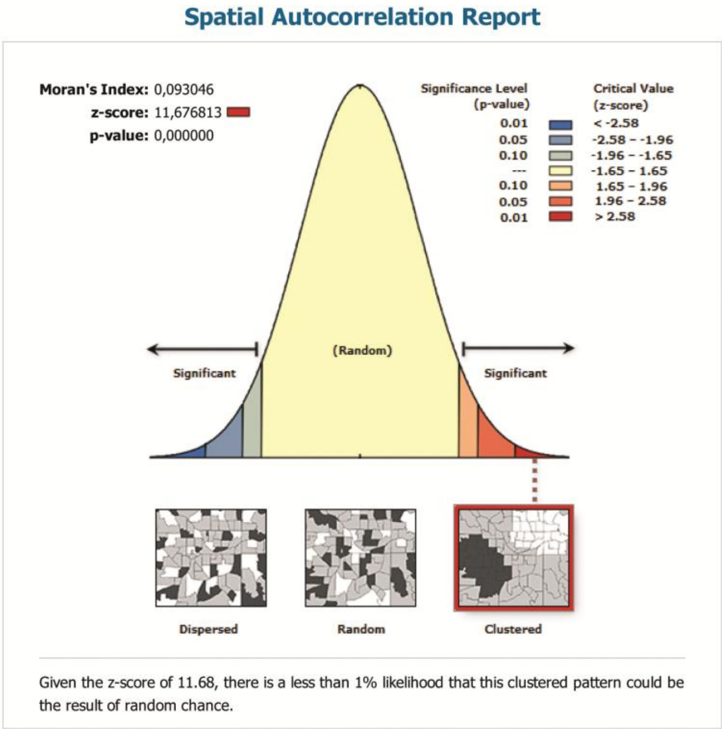


Figure 4.14. Spatial autocorrelation of neighborhood based incidence rate of 2000

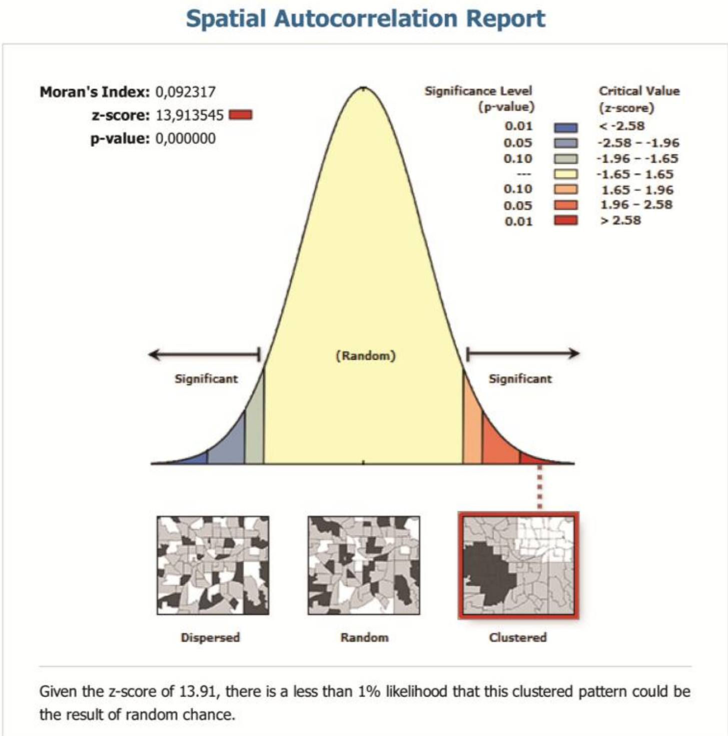


Figure 4.15. Spatial autocorrelation of neighborhood based incidence rate of 2007

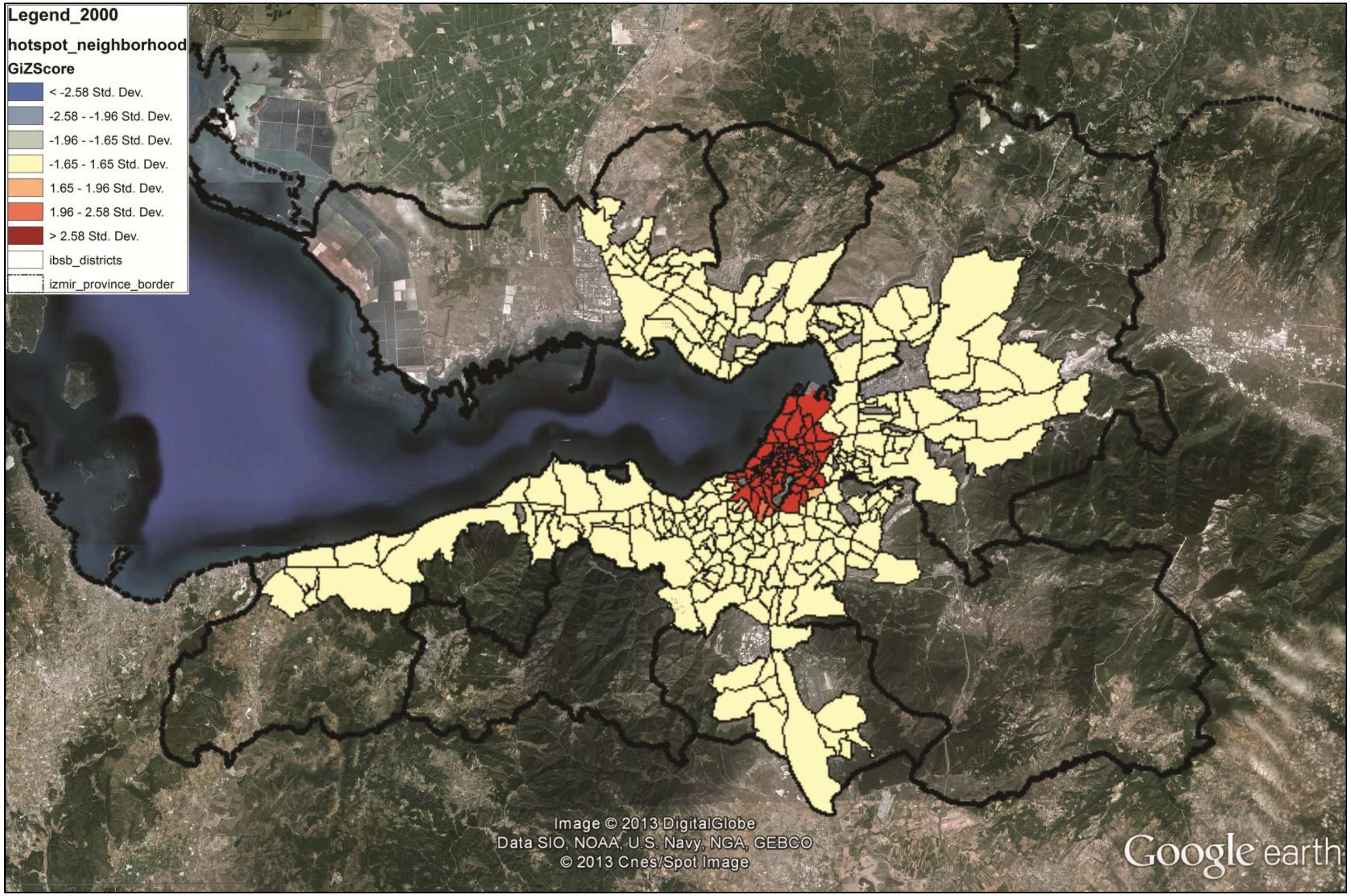


Figure 4.16. HotSpot neighborhood analysis - 2000

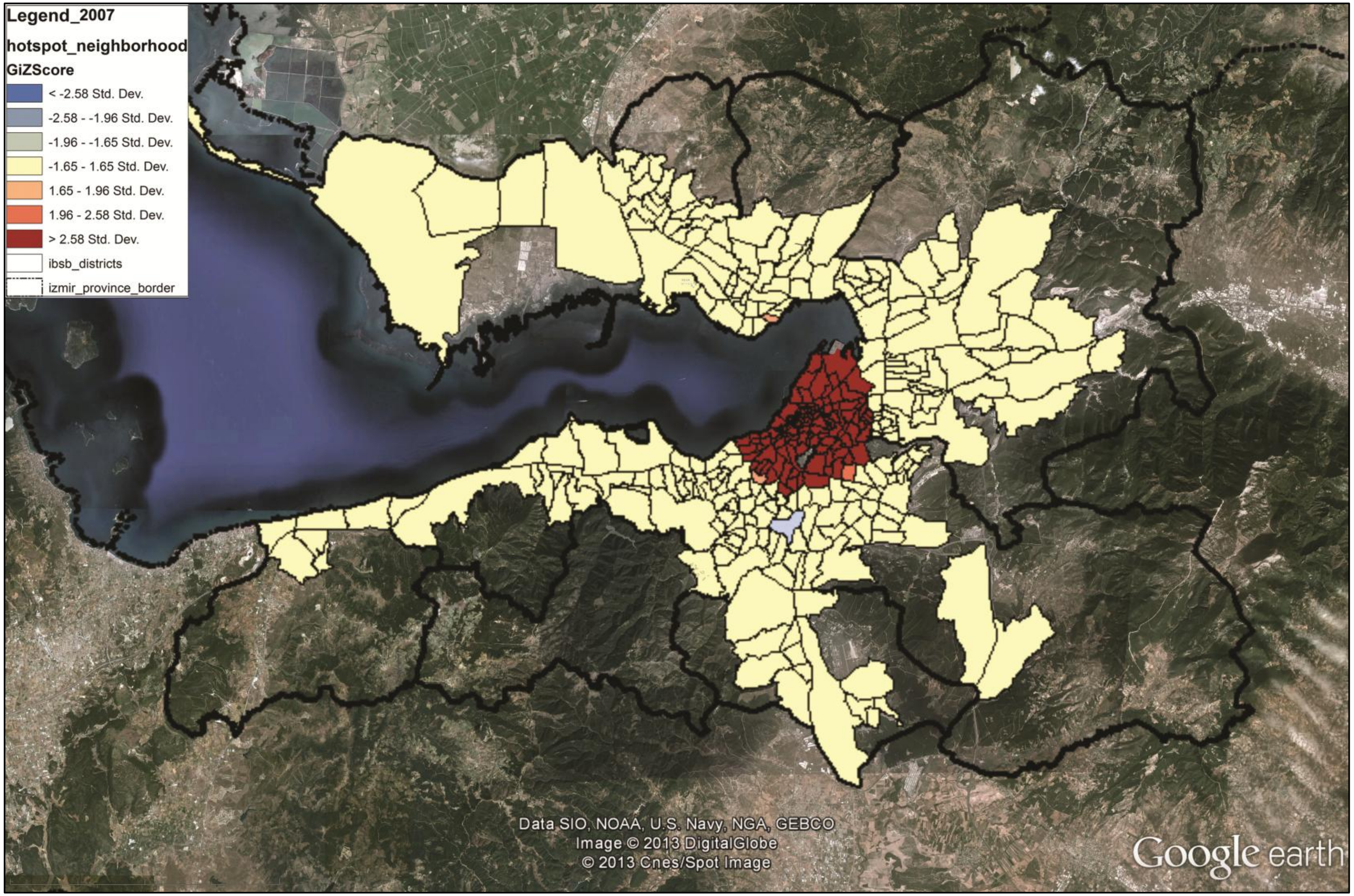


Figure 4.17. HotSpot neighborhood analysis - 2007

4.4. Objective Indicators of Izmir

In Table 4.9, health status data and physical environment dataare shown which are available between 2000 and 2007 time intervals. These data has been obtained from Izmir city Health Profile (İBŞB, 2007b)prepared by Izmir Metropolitan Municipality. In Table 4.9; population density (person/km^2), the annual population growth rate (per thousand), 1^{st} and 2^{nd} grade of Non-Health Organizations (within Izmir Metropolitan Municipality), maternal mortality rate (per hundred thousand), the infant mortality rate (per thousand), employment rate (per cent) are shown on annual basis in the scale of Izmir Province between 2000 and 2007. As observed in the table, except population density, according to the statistics, the other indicators have decreased through the arrangements made after 2005 by the government and municipalities. Also except population density, other indicators are data within the scale of 19 Izmir Metropolitan Municipality's districts. Population density is the data within the scale of 9 Izmir Metropolitan Municipality's districts.

General statistics of socio-economic indicators by districts are shown within the scale of districts in Tables 4.10, 4.11, 4.12 and 4.13, 4.14 (İBŞB, 2007a) and (TÜİK, 2006). These tables contain statistics of population density, population growth rate, employee ratio of main sectors, unemployment rates, literacy rate; average household size, higher education graduates, infant mortality rate, and general budget per capita income. These statistics are required to be able to reveal the socio-economic profiles of the districts and to make comparisons betweendistricts in terms of quality of life.

In Table 4.15 and Graph 4.18, physical environment and lung cancer incidence rate data are shown which are available between 1997 and 2007 time intervals. In the table; PM10, SO_2, metal concentration of Izmir Bay, ASR of lung cancer are shown on annual average basis between 1997 and 2007. Air quality and the metal concentration of Izmir Bay data are taken from both air monitoring stations data of Izmir Metropolitan Municipality and Izmir City Health Profile (2007) prepared by Izmir Metropolitan Municipality. ASR is calculated for the lung cancer data and population data from ICRC of relevant year. All these indicators are data within the scale of 9 districts of Izmir Metropolitan Municipality.

There were four air monitoring stations within Izmir Metropolitan Municipality boundary as located in Alsancak, Bornova, Guzelyali and Karsiyaka as observed in

Table 4.16 until 2007. Number of stations has increased to seven since 2008 and these are located in Bayrakli, Cigli and Sirinyer. Sources of air pollutions are defined as traffic, industrial plants, fuels used for heating purposes during the winter months. Industrial plants within or near the city are the main sources of SO_2 (sulfur dioxide) and fuels used for heating purposes within the city are the main sources of PM10 (particulate matter suspended in air). According to the Air Quality Assessment and Management Regulation, limit value of PM10 was 200 $\mu g/m^3$ and SO2 was 250 $\mu g/m^3$ until 2008, then PM10 was reduced to the value of 112 µg/m3, SO_2 was reduced to the value of 150 $\mu g/m^3$ per year until 2012 within the European Union entrance period. However, when a comparison is made on air quality limit values of EU and Turkey, it is observed that PM10 limit value is 40 µg/m3, SO_2 limit value is 20 $\mu g/m^3$ per year in EU.

In the sediments measurements of the Izmir Bay between 1997 and 2007; mercury (Hg), cadmium (Cd), chromium (Cr), plumbum (Pb), cuprum (Cu) and zinc (Zn) concentrations were measured. In Table 4.15 measured values are annual average values of the inner, middle and outer bay measurements. Due to the industrial pollution, inner bay concentration is higher than the middle and outer bay concentrations. The inner bay measurements are defined as above the Mediterranean background levels.

When all environmental indicators are evaluated, there is an overall decline between the 1997 and 2007 measurements. At increase rate curve, despite the increasing and decreasing periods due to the increase or decrease of cancer records especially increasing in 2004, it remained in the same range.

Table 4.9. Socio-economicstatistics of Izmir Province

	2000	2001	2002	2003	2004	2005	2006	2007
Population density (person/km^2)	2658					2894		2975
Annual population growth rate (per thousand)	24,44							21,88
1^{st} and 2^{nd} grade of Non-Health Organizations (within Izmir Metropolitan Municipality)		262	268	237	122	65	75	29
Maternal mortality rate (per hundred thousand)		25		32		34		22
The infant mortality rate (per thousand)	17,35							14,64
Employment Rates	56,7				48,8	47,1	47,2	

Table 4.10. Socio-economic indicators of metropolitan districts (I)

	Aliağa	Bayındır	Bergama	Beydağ	Çeşme	Dikili	Foça	Karaburun	Kemalpaşa
Population	57192	47214	106536	14147	37372	30115	36107	13446	73114
Urbanization Rate (%)	65,63	33,61	48,97	39,03	67,58	41,68	40,45	21,81	34,81
Population Growth Rate (‰)	30,51	0,19	4,92	-3,37	23,77	26	35,87	39,91	26,53
Population Density (person / km^2)	209	87	62	77	145	59	176	28	112
Population Dependency Ratio (%)	44,51	53,06	47,23	48,49	36,78	44,61	27,65	41,96	51,93
Agricultural Sector Employees Ratio (%)	33,48	79,59	69,06	79,3	31,96	64,25	31,86	61,74	59,43
Industry Sector Employees Ratio (%)	31,95	4,95	7,04	5,6	7,79	5,34	3,61	4,96	18,74
Services Sector Employees Ratio (%)	34,57	15,46	23,9	15,1	60,25	30,42	64,53	33,3	21,84
Unemployment Rate (%)	6,1	2,86	4,67	3,35	10,27	4,21	2,21	2,37	3,64
Literacy Rate (%)	94,14	82,3	88,03	84,15	96,12	91,2	94,55	95,84	89,89
Infant Mortality Rate (‰)	31,92	32,38	35,29	25,97	55,67	42,14	23,35	44,03	41,01
General Budget Per Capita Income (Tl)	1009454	663S6	84714	60997	174455	97431	97895	62878	511203

Table 4.11. Socio-economic indicators of metropolitan districts (II)

	Kınık	Kiraz	Menderes	Menemen	Ödemiş	Seferihisar	Selçuk	Tire	Torbalı	Urla
Population	32109	44910	73002	114457	128259	34761	33594	78658	93216	49 269
Urbanization Rate (%)	40,91	22,27	23	40,26	48,26	50,42	75,65	54,65	40,87	74,24
Population Growth Rate (‰)	-15,83	8,51	32,14	40,88	2,6	48,47	20,55	1,72	26,35	32,86
Population Density (person/km^2)	72	79	94	165	126	90	120	88	165	70
Population Dependency Ratio (%)	51,95	53,52	45,04	55,71	46,7	40,44	49,03	49,63	54,11	41,48
Agricultural Sector Employees Ratio (%)	80,09	86,8	62,81	57,86	70,42	48,25	44,65	68,13	60,86	35,01
Industry Sector Employees Ratio (%)	5,05	2,89	11,46	13,73	7,06	9,02	6,77	9,41	16,06	8,58
Services Sector Employees Ratio (%)	14,86	10,31	25,73	28,41	22,52	42,73	48,58	22,46	23,08	56,41
Unemployment Rate (%)	3,21	2,68	3,03	4,76	3,99	6,59	8,7	4,18	4,51	8,35
Literacy Rate (%)	87,3	81,19	89,87	87,34	87,42	94,37	88,62	87,11	85,41	94,39
Infant Mortality Rate (‰)	39,59	36,36	44,47	47,8	28,33	53,39	49,82	30,71	38,55	41,75
General Budget Per Capita Income (Tl)	47713	39017	254986	17292	85191	85251	124392	124481	6074916	122187

Table 4.12. Socio-economic indicators of Izmir Districts

District	Total Population			Annual Population Growth Rate (per thousand)	Area km²	Population Density (km²/person)	Population Density (km²/person)
	1990	2000	2007			2000	2007
Balcova	59.825	66.877	74.837	11,14	21.22	3.185	3 527
Bornova	278.300	396.770	476.153	35,46	224.15	1.771	2 124
Buca	203.383	315.136	400.930	43,78	133.90	2.352	2 994
Cigli	78.462	113.543	144.251	36,95	96.93	1.171	1 488
Gaziemir	44.089	87.692	109.291	68,74	62.84	1.392	1 739
Guzelbahce	14.269	18.190	19.255	24,27	116.91	155	165
Karsiyaka	345.734	438.764	515.184	23,82	65.70	6.648	7 841
Konak	721.570	782.309	848.226	8,08	69.40	11.338	12 222
Narlidere	34.844	54.107	61.455	44	63.17	859	973
Aliaga	42.150	57.192	60.043	30,51	273.65	209	219
Bayindir	47.126	47.214	42.152	0,19	540.22	87	78
Bergama	101.421	106.536	102.581	4,92	1720.29	62	60
Beydag	14.613	14.147	13.500	-3,37	183.94	77	73
Cesme	29.463	37.372	27.796	23,77	256.51	145	108
Dikili	23.219	30.115	27.348	26	509.60	59	54
Foca	25.222	36.107	30.549	35,87	204.49	176	149

Table 4.12. Socio-economic indicators of Izmir Districts (cont.)

District	Total Population			Annual Population Growth Rate (per thousand)	Area km²	Population Density (km²/person)	Population Density (km²/person)
	1990	2000	2007			2000	2007
Karaburun	9.020	13.446	8.040	39,91	484.33	28	17
Kemalpasa	56.075	73.114	81.777	26,53	655.06	112	125
Kinik	37.617	32.109	27.938	-15,83	446.33	72	63
Kiraz	41.247	44.910	45.072	8,51	571.96	79	79
Menderes	52.934	73.002	64.065	32,14	775.17	94	83
Menemen	76.043	114.457	126.934	40,88	694.49	165	183
Odemis	124.968	128.259	128.253	2,6	1015.7	126	126
Seferihisar	21.406	34.761	25.830	48,47	385.83	90	67
Selcuk	27.353	33.594	34.002	20,55	279.85	120	122
Tire	77.314	78.658	76.327	1,72	891.46	88	86
Torbali	71.617	93.216	119.506	26,35	565.28	165	211
Urla	35.467	49.269	48.058	32,86	703.65	70	68
Total	2.694.770	3.370.868	3.739.353	22,38			

Table 4.13. Socio-economic indicators of Izmir Districts (II)

District	Literacy Rate (%)	Higher Education Graduates (%)	Average Household Size (%)	Unemployment Rate (%)	Employee Ratio of Industrial Sectors (%)
Balcova	95,6	16,00	3,3	16,7	16,6
Bornova	94,2	12,6	3,6	13,7	32,6
Buca	93,2	7,8	3,7	15,6	31,0
Cigli	93,3	8,9	3,7	16,6	33,3
Gaziemir	94,4	13,4	3,7	7,7	24,9
Guzelbahce	94,9	15,3	3,4	7,7	12,3
Karsiyaka	93,7	16,2	3,5	16,5	27,9
Konak	92,4	12,2	3,5	16,4	28,9
Narlidere	93,2	20,6	3,6	13,1	9,4
Aliaga	94,1	9,0	3,6	6,1	31,9
Bayindir	82,3	2,6	3,6	2,9	5,0
Bergama	88,0	4,3	3,5	4,7	7,0
Beydag	84,2	2,2	3,4	3,4	5,6
Cesme	96,1	21,1	3,4	10,3	7,8
Dikili	91,2	9,8	3,3	4,2	5,3
Foca	94,6	17,1	3,5	2,2	3,6
Karaburun	95,8	16,1	3,4	2,4	5,0
Kemalpasa	89,9	4,0	3,9	3,6	18,7
Kinik	87,3	2,2	4,0	3,2	5,1
Kiraz	81,2	2,0	4,0	2,7	2,9
Menderes	89,9	7,7	3,8	3,0	11,5
Menemen	87,3	5,3	4,1	4,8	13,7
Odemis	87,4	4,1	3,4	4,0	7,1
Seferihisar	94,4	14,8	3,6	6,6	9,0
Selcuk	88,6	7,7	3,7	8,7	6,8
Tire	87,1	4,5	3,4	4,2	9,4
Torbali	85,4	4,4	4,0	4,5	16,1
Urla	94,4	13,8	3,5	8,3	8,6

Table. 4.14. Employment Concentration Coefficients of Main Sectors in Districts of Izmir: 2000

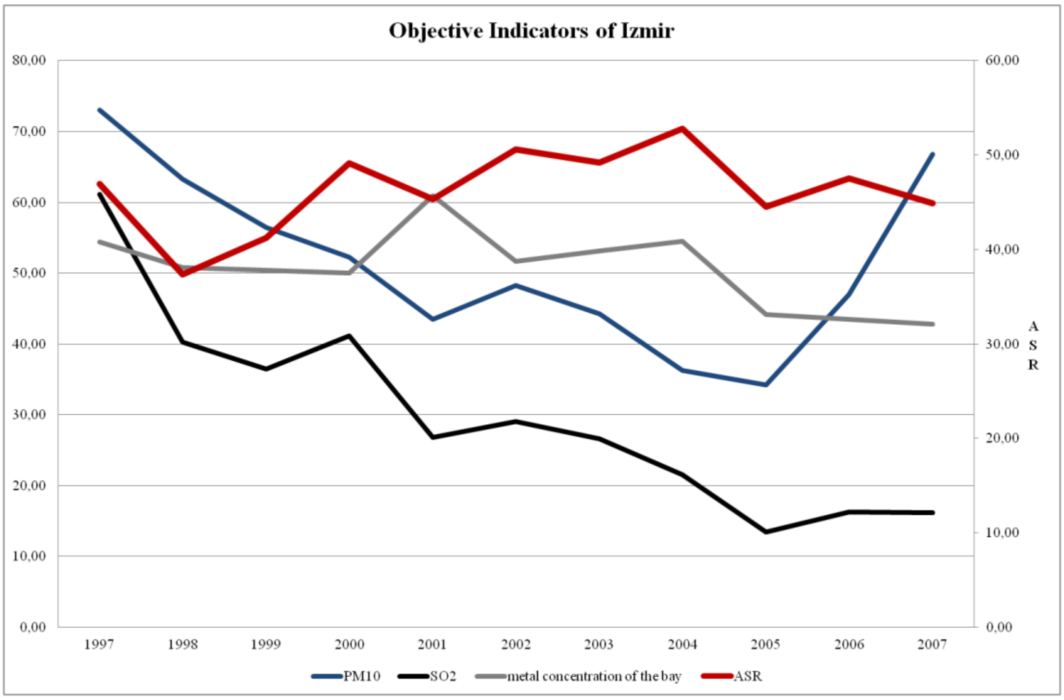
	Agriculture	**Industry**	**Buılding Trade**	**Service**
Metropolitan Municipality	0,6525	**1,1648**	**1,0974**	**1,1319**
Balcova	0,0863	0,8063	**1,2161**	**1,6345**
Bornova	0,0826	**1,5835**	**1,1224**	**1,2968**
Buca	0,1301	**1,5080**	**1,4627**	**1,2616**
Cigli	0,2030	**1,6159**	**1,4390**	**1,1700**
Gaziemir	0,4528	**1,2110**	0,8614	**1,2634**
Guzelbahce	1,0148	0,5968	**1,1075**	**1,1603**
Karsiyaka	0,0276	**1,3564**	**1,4504**	**1,3956**
Konak	0,0279	**1,4047**	**1,0700**	**1,4179**
Narlidere	0,1137	0,4581	**1,0371**	**1,7954**
Aliaga	**1,1731**	**1,5523**	**1,0797**	0,6330
Bayindir	**2,7884**	0,2406	0,3031	0,3040
Foca	**1,1163**	0,1752	0,3843	**1,3711**
Kemalpasa	**2,0820**	0,9103	0,7875	0,3876
Menderes	**2,2006**	0,5568	0,5811	0,4970
Menemen	**2,0271**	0,6670	0,9676	0,5110
Seferihisar	**1,6904**	0,4383	**1,5197**	0,7610
Selcuk	**1,5644**	0,3290	0,9223	0,9586
Torbali	**2,1322**	0,7803	0,8501	0,4076
Urla	**1,2267**	0,4168	**1,3636**	**1,0792**
Metropolitan Districts	**2,4263**	0,3236	0,6002	0,4587
Bergama	**2,4196**	0,3421	0,4636	0,4705
Beydag	**2,7782**	0,2722	0,3617	0,2893
Cesme	**1,1196**	0,3785	**1,7531**	**1,1183**
Dikili	**2,2509**	0,2593	**1,2372**	0,5236
Karaburun	**2,1632**	0,2408	**1,0312**	0,6108
Kinik	**2,8059**	0,2456	0,3131	0,2896
Kiraz	**3,0412**	0,1405	0,2268	0,1998
Odemis	**2,4673**	0,3428	0,4933	0,4368
Tire	**2,3868**	0,4572	0,5591	0,4279
Izmir Province	1,0000	1,0000	1,0000	1,0000

Table 4.15. Physical environment statistics and lung cancer incidence rate

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
PM10(µg/m3)	73	63,25	56,5	52,25	43,5	48,25	44,25	36,25	34,25	47	66,75
SO2(µg/m3)	61,17	40,28	36,47	41,16	26,84	29,09	26,59	21,52	13,44	16,28	16,23
Metal concentration of Izmir Bay(µg/g)	54,38	50,75	50,39	50,03	60,93	51,71	53,12	54,53	44,12	43,48	42,85
ASR of lung cancer	46,91	37,34	41,21	49,14	45,37	50,63	49,20	52,79	44,57	47,51	44,88

Table 4.16. Air monitoring station and PM10 and SO_2 annual averages for Izmir

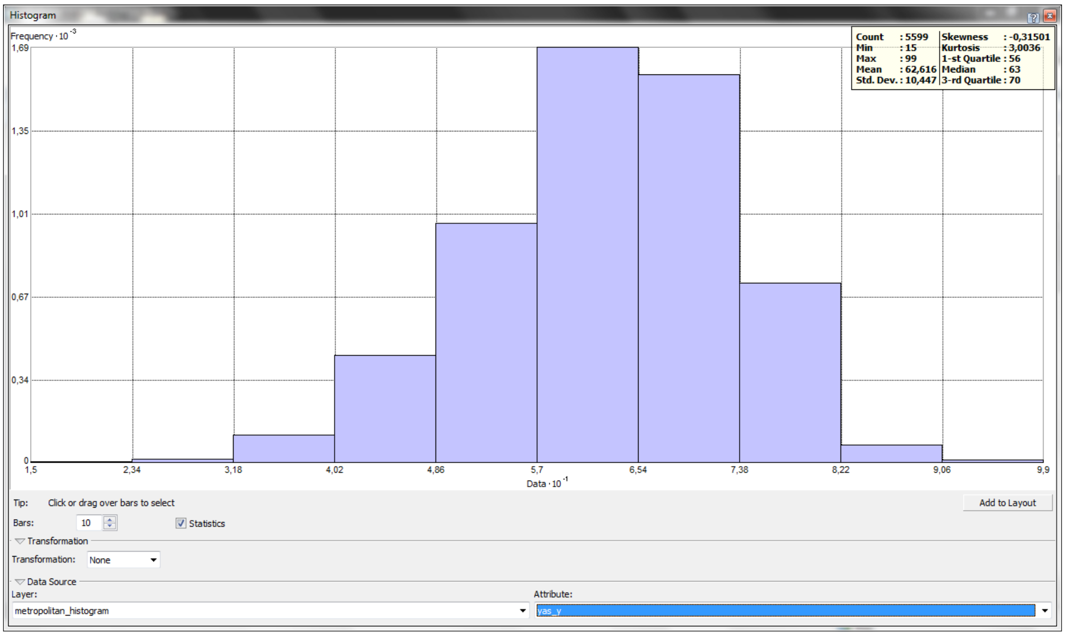
PM10	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Alsancak	80	62	67	67	53	55	43	30	14	37	90
Bornova	70	71	60	50	37	39	37	39	59	60	60
Guzelyali	75	65	56	56	52	57	53	40	38	45	43
Karsiyaka	67	55	43	36	32	42	44	36	26	46	74
SO_2											
Alsancak	90	58	59	54	24	30	43	36	16	30	28
Bornova	32	25	21	27	23	24	25	22	15	12	13
Guzelyali	73	41	37	45	30	29	19	13	10	7	6
Karsiyaka	50	37	29	39	30	33	20	15	12	16	18



Graph 4.18. Objective indicators of Izmir

If the incidence rate and spatial autocorrelation statistics of lung cancer cases are interpreted referring the district and neighborhood results, general socio-economic and environmental indicators are required to be evaluated within the context of Konak, Cesme and Urla as mentioned in section 4.1.

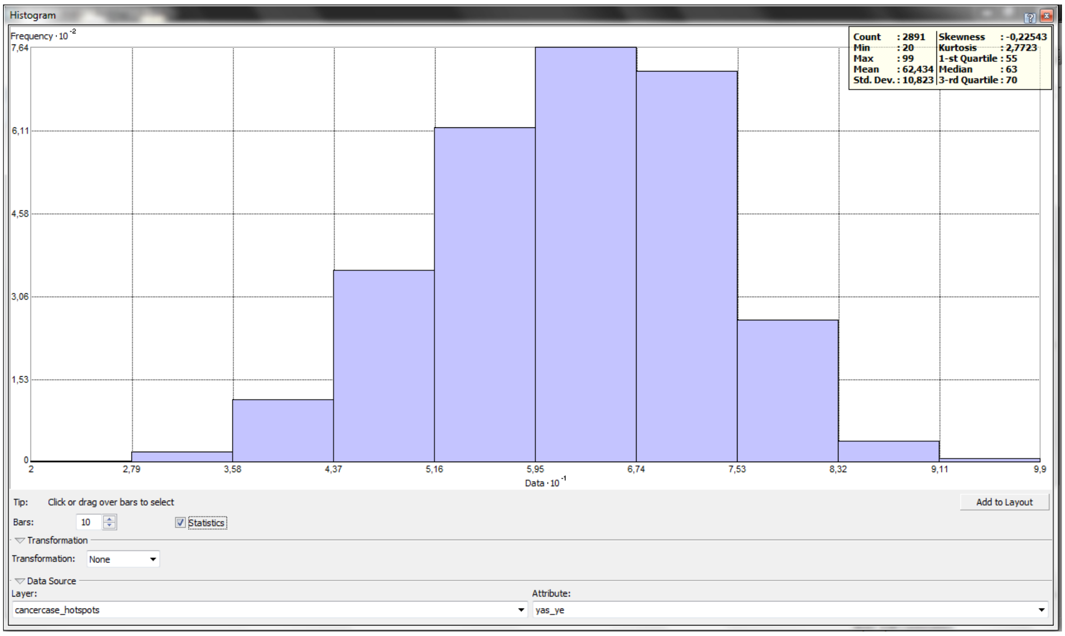
In the context of socio-economic and age profile of metropolitan districts, as reference to Table 4.12 and 4.13; it is evaluated that unemployment rate, urbanization rate, service sector employee rate, literacy rate are higher in the context of Urla and Cesme comparing to the other metropolitan districts. On the other hand, population density and infant mortality rate statistics are higher in Cesme than other districts; however these are lower in Urla case. Per capita income rate is observed average in Urla and Cesme, it is at lower degree than many districts like Torbali and Kemalpasa having a high rate of employee in industry sector. The average age interval of lung cancer patients is detected as 57-65 observed in the Graph 4.19.



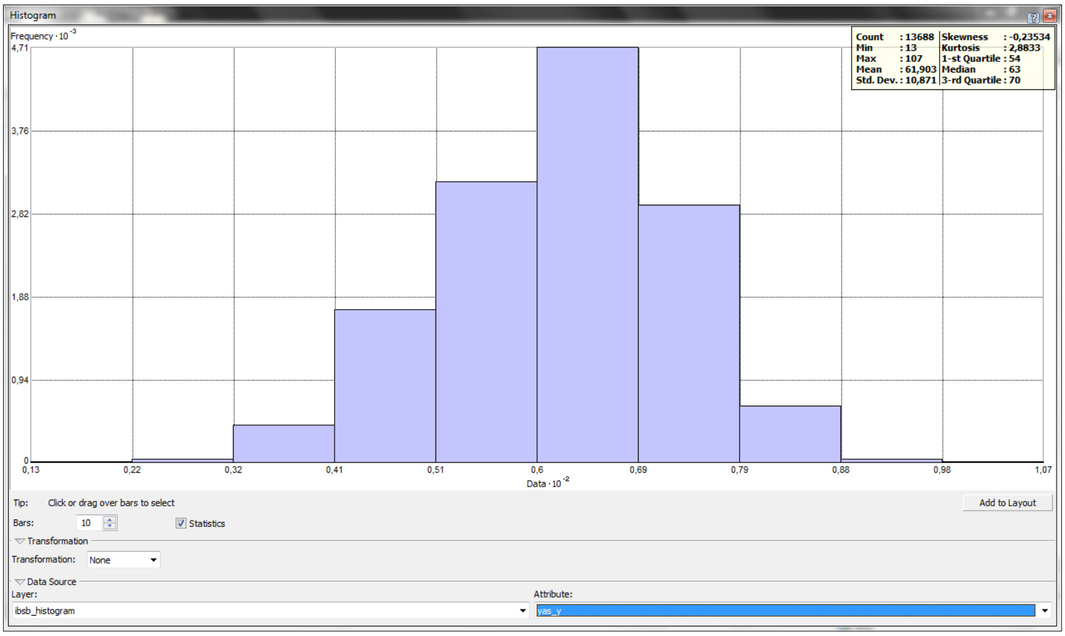
Graph 4.19. Age histogram of metropolitan districts

In the context of environmental, socio-economic and age profile of Konak, as reference to Table 4.11, 4.15 and 4.16 it is evaluated that PM10 and SO_2 measurements are higher than other central districts. Also population density, literacy rate, employee rate in industry, building trade and service sectors are higher. Employee rate in industry rate is the highest after Bornova, Buca and Gaziemir. Unemployment rate and household size rate are almost same with the other central districts. On the other hand, population growth rate is the lowest within other districts. The average age interval of lung cancer patients is detected as 59-67 observed in Graph 4.20.

Also the average age interval of central districts is 60-69 observed in Graph 4.21.



Graph 4.20. Age histogram of Konak District



Graph 4.21. Age histogram of Izmir Metropolitan Municipality

4.5. General Evaluation of Spatial Point Pattern and Statistical Analysis

In Chapter 4, the case counts, population of districts and cancer incidence statistics werecalculated and their graphs were performed for Izmir Province. Further, in order to find out whether the high incidence rate is clustered, dispersed or random, spatial autocorrelation has been measured based on feature locations of cancer cases and feature values of incidence rate of neighborhoods for 2000 and 2007 data. The null hypothesis states that there is no spatial clustering of the case values associated with the geographic features in the study area. Since the p-value is small, the absolute value of the standard deviation (Z score) is large that it falls outside of the confidence level and the index value is greater than 0 for both values of two years, it is unlikely that the observed spatial pattern of cancer cases was the result of random processes, so the null hypothesis has been rejected with a confidence level of 99. It is interpreted that the values of incidence rates in the dataset is clustered spatially and also it has been referred that high values cluster near other high values within the context of the incidence rate of each neighborhood units. The same trend is almost seen in both incidence rate values of 2000 and 2007 calculated according to the case numbers and address-based population census of neighborhoods in each year. According to the incidence rate pattern map of 2000, 94% of them are detected as hotspots and they cluster within the Konak district. The same trend is seen in 2007, the hotspots are occurred in the same place, 92% of them are within the Konak districts. Since the Global Moran's I has been an inferential statistics and when the interpretation isperformed in the context of high density of lung cancer cases in Konak, it has been essential to evaluate objective indicators. In terms of environmental contamination data, air pollution measurement is available in the scale of districts. Also in terms of socio-economic data; population density, literacy, employee and unemployment rates, household size rate and population growth rate are available in the scale of districts. As observed of them, although objective indicators are lacking, there could be lack of data entry by the ICRC and the genetic factors of individuals are not included; the place of cluster has high level of literacy and employment rate and low level of population growth rate. Besides population density, air pollution measurements are high level and the age of patients are above 60. All these results of indicator statistics support the significance of the outcome of the spatial statistics.

CHAPTER 5

CONCLUSION

This thesis has examined the urban environment quality in framework of public health. Spatial pattern of lung cancer, cancer incidence rate and objective indicators were explained in the context of Izmir Province. The clusters of neighborhoods with high incidence rates were identified based on time series cancer data. They have been analyzed in terms of spatial pattern, and also, socioeconomic characteristics at district level for Izmir Province. These analyzes were used to clarify the relationship between the spatial pattern and objective indications. GIS tools have been used to create and analyze maps of cancer pattern in the thesis.

This Chapter discuss findings in two parts namely the result of thesis and recommendation and future prospects for further studies.

5.1. Results of The Study

As explained in the previous chapters, the main aim was to comprehend, examine and discuss whether there has been a significant relationship between lung cancer density in a specific location and the quality of life in that place. The hypothesis was that there was a spatial relationship between urban environmental quality and lung cancer spatial patterns. In terms of the aim and the hypothesis, this thesis revealed the following questions. The main question is:

What is the relationship between urban environmental quality and health?

Sub questions were:

- What are the determinants of urban environmental quality?
- What is the relationship between urban environmental quality, quality of life and human health?
- What are the quality of life indicators?
- What is the vital point in mapping the spatial distribution of cancer cases?

It is undeniable the fact that the socio-economic profile of the citizens living in a particulararea is an important input to be able to explain the relationship between the environmental quality and QOL. In Chapter 2, QOL has beendiscussed as it relates to place which corresponds to the geography or environments of individuals and groups of individuals such as households, neighborhoods and communities. It has been clearly understood from Chapter 2, the QOL concept has two frameworks.The first one is the conditions of the environment, such as air and water pollution, or poor housing. The second one is socio economic profile such as health or educational achievement. Their effects on QOL have been an issue that researches are interested in. The main emphasis has given to the evaluation of objective indicators of a particular place. Additionally, in order to discuss the significance of the relationship, socio-economic data are examined within the objective indicators. In studies of lung cancer pattern, it was mentioned that there were differences in patterns of lung cancer among different genders and different age groups. It was highlightedin literature, studies, subjected proximity to industry, smoking, occupational exposure or socioeconomic factors, emphasize age of individuals.

Different approaches of theoretical studies have been differentiated in terms of conceptual, descriptive and normative approaches to environmental quality. Thus, it was evaluated that construction a uniform multidisciplinary framework is important in terms of accumulation of knowledge. This result leadedresearches to study with different disciplines. It has been required to develop a model to analyze the relationships of indicators and to test hypotheses about the relationships. The model is determined using statistical techniques.Testing and estimating the relationships among variables and causal relations is detected using a combination of statistical data and qualitative causal assumptions.

In Chapter 3, the methodology of the thesis has been mentioned as abstract and concrete researches. In concrete research, the spatial pattern was formed using approximately 18.000 lung cancer cases, approved by the reliability of WHO, on the base of point pattern in GIS environment. The cancer incidences were calculated and displayed by thematic maps within the time interval of 1992-2007 in order to present the rate of spread of lung cancer in the population. In this period, there were some limitations about the cancer data. These limitations might cause misleading interpretation on spatial pattern. They were missing address data, the single address line for whole address information, data out of Izmir and a few duplications. For these limitations, 1203 cases in Izmir Greater Municipality and 34 cases in metropolitan districts data input could not be pointed to the base map.

In Chapter 4, the case counts, population of districts and cancer incidence statistics werecalculated and their graphs were performed for each districts of Izmir Province. Further, in order to find out the whether the high incidence rate is clustered, dispersed or random, spatial autocorrelation has been measured based on feature locations of cancer cases and feature values of incidence rate of neighborhoods for 2000 and 2007 data. Since the p-value is small, the absolute value of the standard deviation (Z score) is large that it falls outside of the confidence level and the index value is greater than 0 for both values of two years, so the null hypothesis has been rejected with a confidence level of 99. The omitted values of cancer cases which cannot entered to the dataset, do not generate a bias in the hypothesis testing statistics. It is interpreted that the values of incidence rates in the dataset is clustered spatially and also it has been referred that high values cluster near other high values within the context of the incidence rate of each neighborhood units. The same trend is almost seen in both incidence rate values of 2000 and 2007.

According to the incidence rate pattern map of 2000, 94% of them are detected as hotspots and they cluster within the Konak district. The same trend is seen in 2007, the hotspots are occurred in the same place, 92% of them are within the Konak districts.

Since the Global Moran's I has been an inferential statistics and when the interpretation isperformed in the context of high density of lung cancer cases in Konak, it has been essential to evaluate objective indicators. Environmental contamination data and also socio-economic data are available in the scale of districts. As observed in the indicator statistics, although objective indicators aremissing, there could be lack of data entry by the ICRC and the genetic factors of individuals are not included; within the place of cluster, objective indicators of urban life quality show high level status in terms of health determinants such as population density, air pollution, literacy rate, employment rate and population growth rate. Additionally, the age of patients are above 60 in the case of Konak. All these results reveals that the significance of the outcome of the spatial statistics.

5.2. Recommendations and Future Expectations for Further Studies

There are many issuesthat could be explored in further studies based on findings and results of the study. The further studies can be classified in terms of improving objective and subjective indicators as well as epidemiology of cancer in the context of planning discipline.

It is vital to develop planning vision and policies in order to improve quality of urban environment and decrease the negative effects of environmental factors on individuals. For instance ecological land use planning, open space preservation, tree planting, supporting public transport and pedestrian traffic, energy efficient buildings and energy conservation in general, water conservation, and wastewater reuse, recycling of food and other solid wastes, reduction of industrial wastes, enforcing air/noise pollution control, to make industrial facilities to be located in organized industrial zones etc. are recommended implementations can be done with planning tools.

In terms of objective indicators, secondary data,in addition to air quality, should be find out from governmental agencies such as water quality, density of green area, housing conditions, traffic density, land use types, etc. In terms of subjective indicators, social surveys should be done as a subjective approach to assess peoples' behaviors and evaluations about aspects of QOL in general and QOUL in particular. In survey, it is important to gain knowledge about smoking habits, genetic factors and socio-economic features of individuals.

On the other hand, there are challenging issued both in health services and registry systems in cancer studies. Due to the increase in the number of cancer registry in specific years, it can be expected that as there would be an increase in number of cancer cases in those years. These challenges are classified as follows:

1. Deficiency of basic health services: Insufficient number of medical personnel in hospitals might be too busy to keep precise and detailed records. The deficiency in diagnosis and treatment capabilities hampers diagnosis of cancer.

2. Lack of demographical data: Most of the developing countries do not have a reliable and updated demographical data for whole population. Additionally, there has been a steady migration because of various reasons and these movements cannot be recorded. Another challenge is duplicated data. The skilled personnel are required to avoid such errors. Every person is assigned a unique identity number in the developed

countries. However, some developing countries in particularly third World countries do not use such a system. They just use patient's name, surname and his/her father's name in order to distinguish patients from each other.

3. Lack of trained staff: Data collection, saving, analysis, queries, interpretation and ability to use this data require collaborative work of qualified experts trained in different disciplines.

4. Patient monitoring: Monitoring data allows the cancer registrars to review the accuracy of data at hand. Additionally, this data is also necessary to measure the effectiveness of the treatment and calculate the survival rates.

5. Lack of devices and tools, financial problems: Cancer registry centers donot have adequate technical infrastructure and insufficient budget provided by the state.

6. Institutionalization issues: Cancer registry center has to collect data from all private and public hospitals whichdiagnose and treatment cancer as well as hospitals specialized in cancer treatment. Additionally, death certificates and related demographic information should be provided by other governmental agencies s. Legal arrangements and improvements must be made for the smooth performance of the activities.

The expectations of cancer studies in future can be listed as follows:

1. Provision of reliable, continuous and stable demographical data.
2. Foundation a national cancer control and develop cancer registry policy.
3. Establishments necessary regulations to train skilled personnel needed for cancer registry centers and collaboration of different experts. Additionally, publication of the collected data at regular intervals should be available to public and researches.
4. Verification of the collected data and quality controls at regular intervals is vital to data quality.
5. Cohort type cancer studies are necessary to explainsignificance of cancer distribution.

The results from this study would serve as the basis for further assessment of spatialassociation between lung cancer incidence rate and environmental factors. This would help public health managers and planners in regulation, control and monitoring of environmental contamination and to better allocate resources, also manage health care facilities and its services. On the other hand, "health for all" is the content of EXPO 2020, Izmir is candidate to be held in. This study can be presented in EXPO 2020 and more extensive research project should be done to increase the awerness of cancer.

Furthermore, this thesis is a leading work for development of policies on precaution against cancer, development of health and planning policies, allocating resources, epidemiological studies of cancer control programs.

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APPENDIX A

LUNG CANCER CASE DISTRIBUTION OF DISTRICTS

For each districts in Izmir, detailed lung cancer distribution maps are prepared. Konak, Gazimeir, Urla and Cesme Districts are examined in detail in Chapter 4, Section 4.2. The other districts are given in this part as alphabetically.

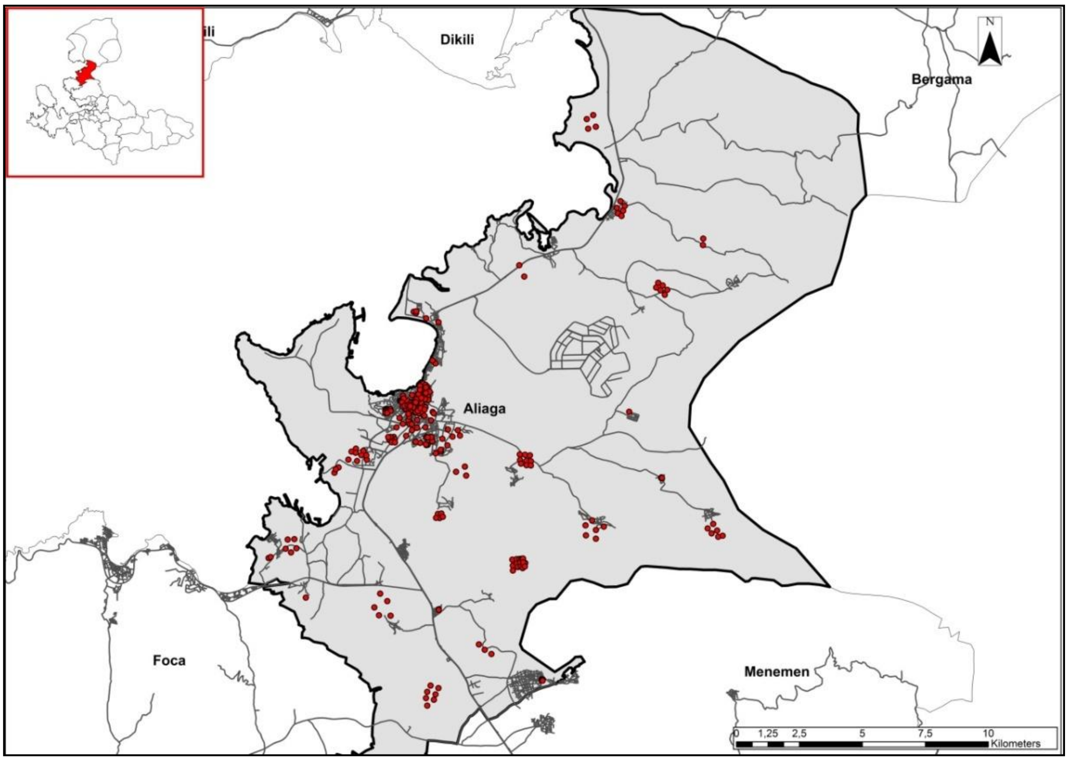

Figure A.1. Aliaga

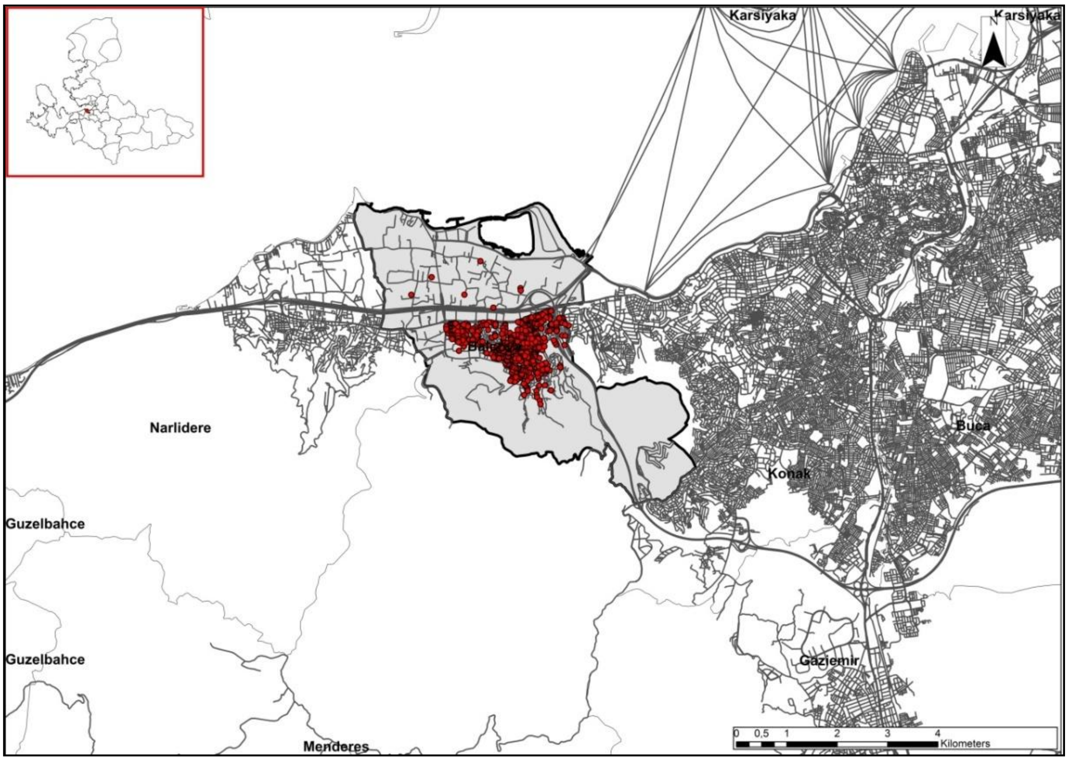

Figure A.2. Balcova

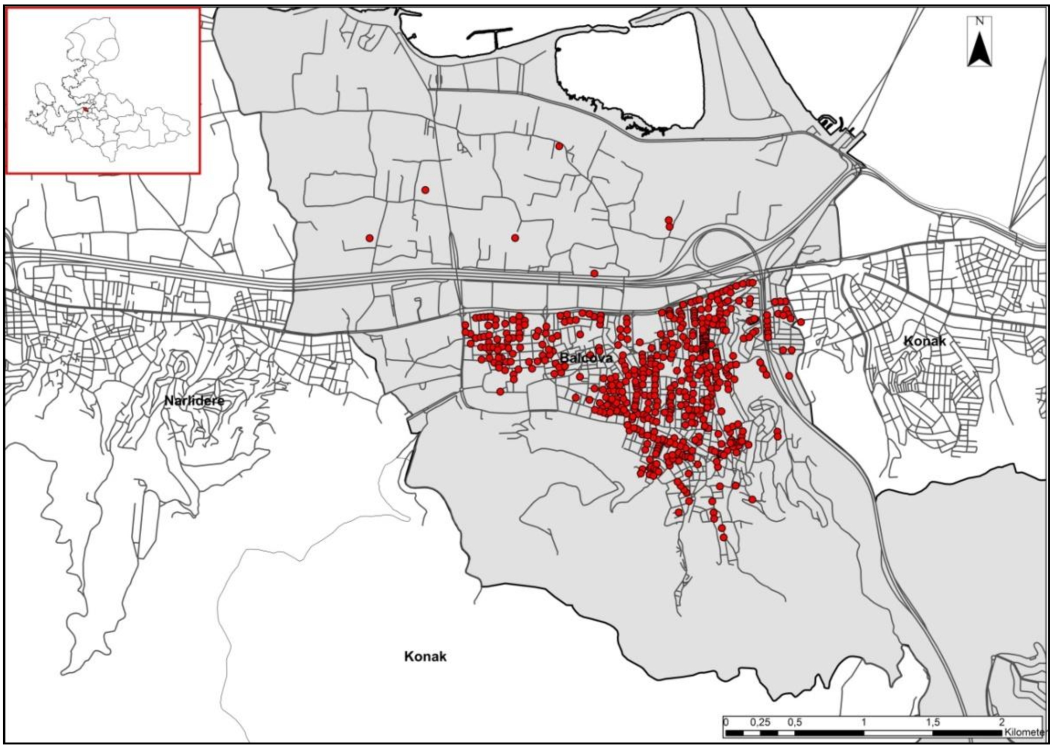

Figure A.3. Balcova in detail

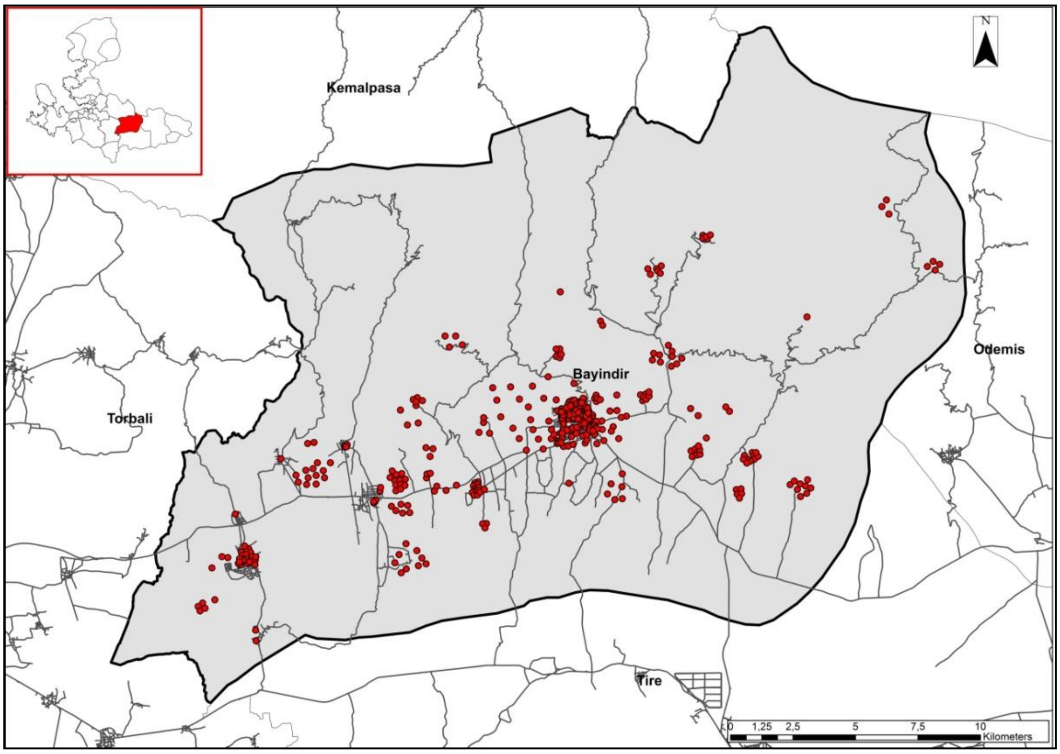

Figure A.4.Bayindir

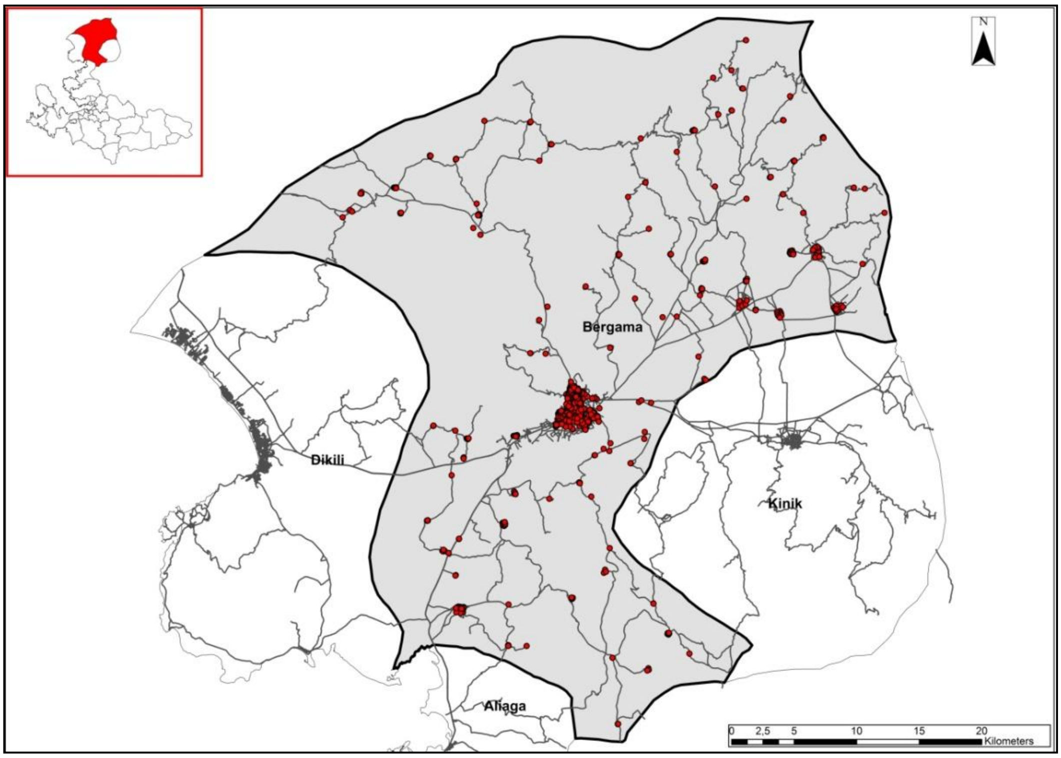

Figure A.5. Bergama

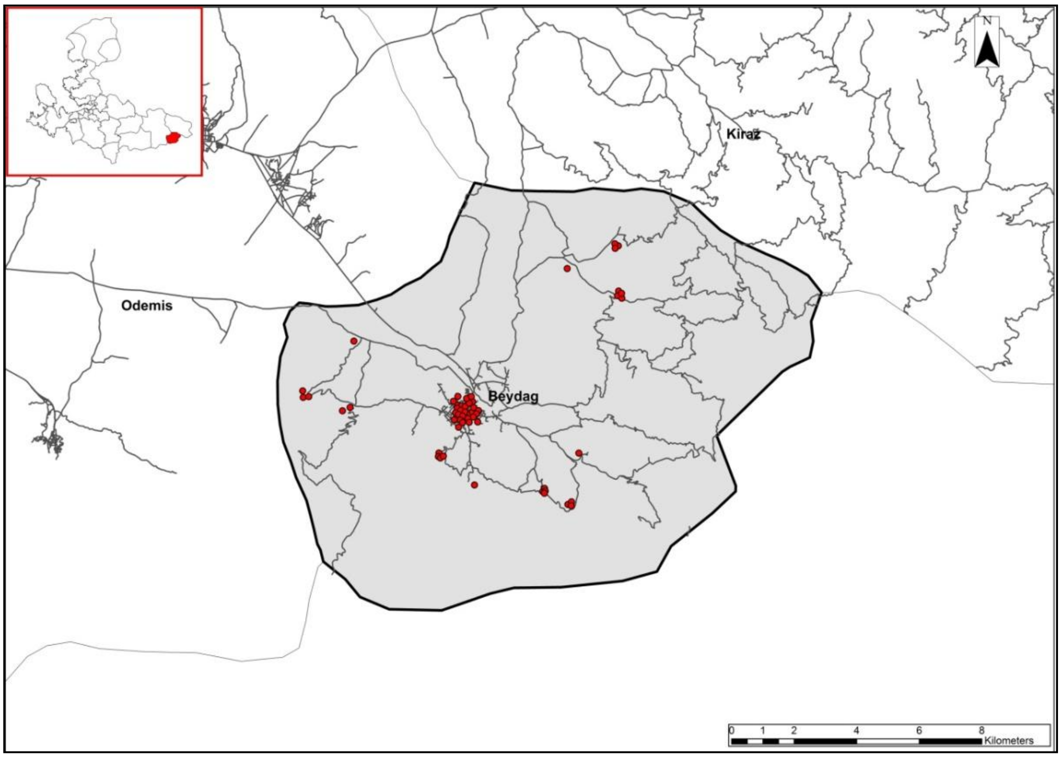

Figure A.6. Beydag

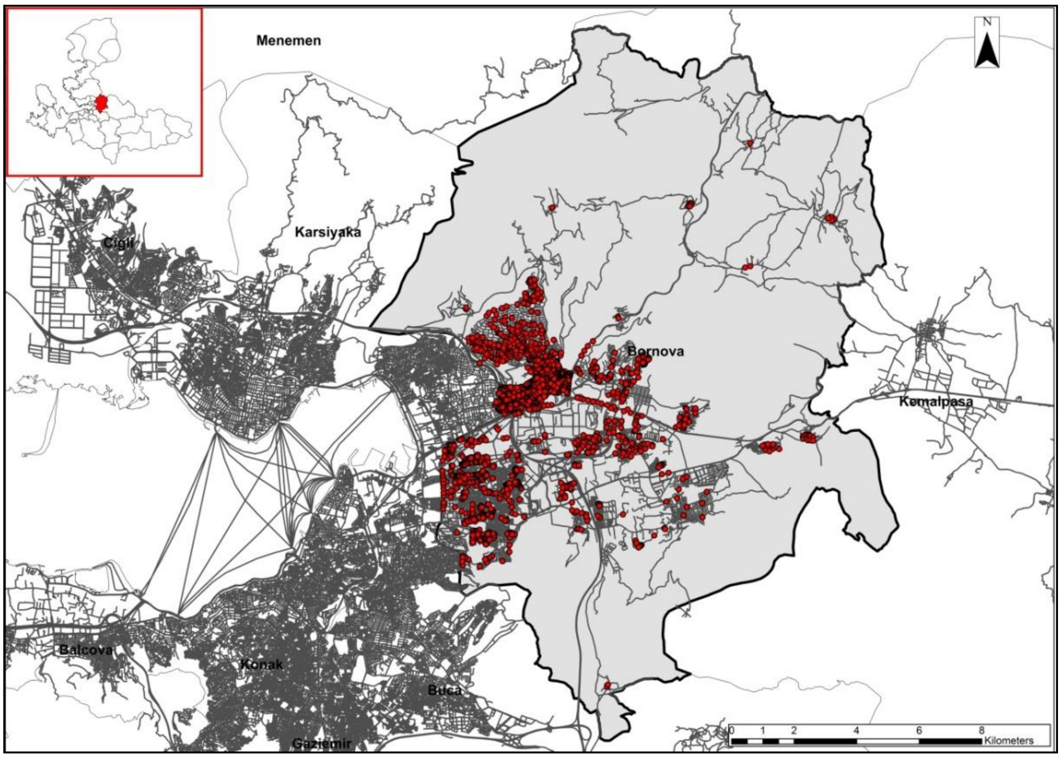

Figure A.7. Bornova

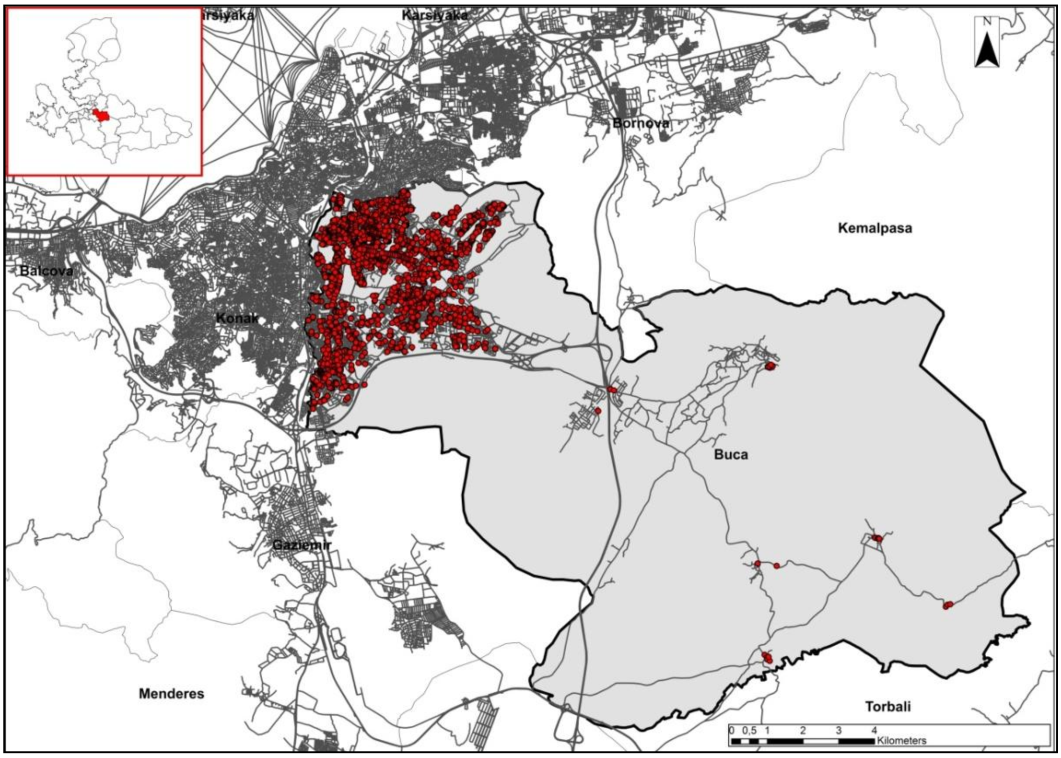

Figure A.8. Buca

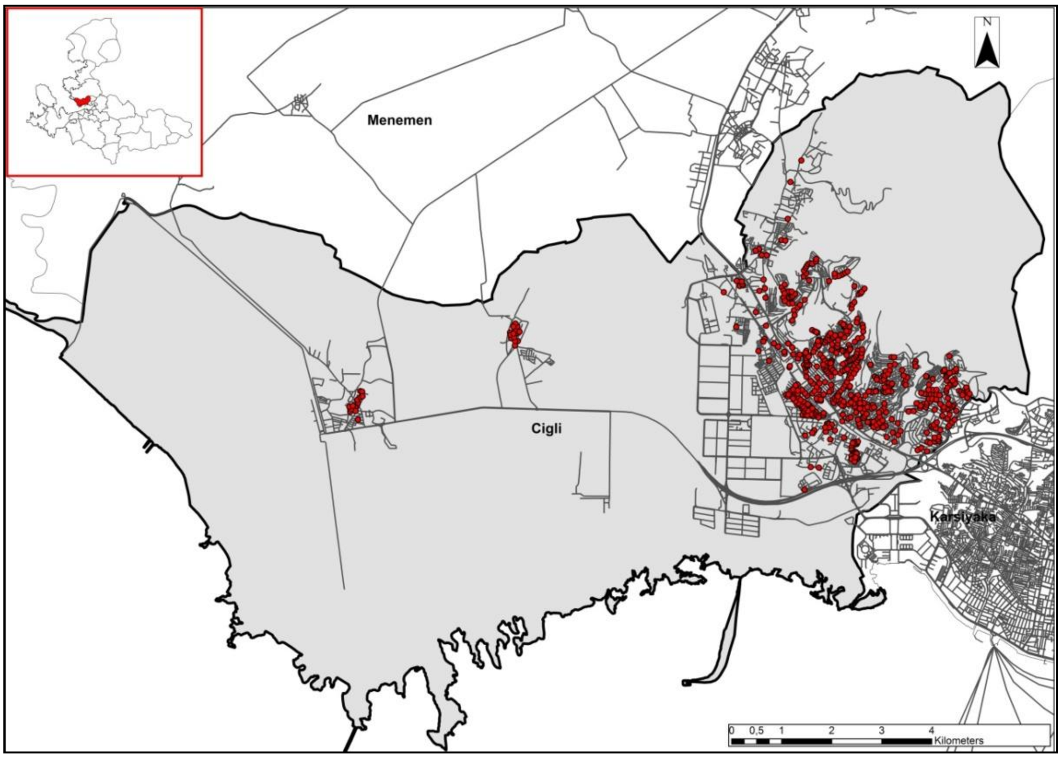

Figure A.9. Cigli

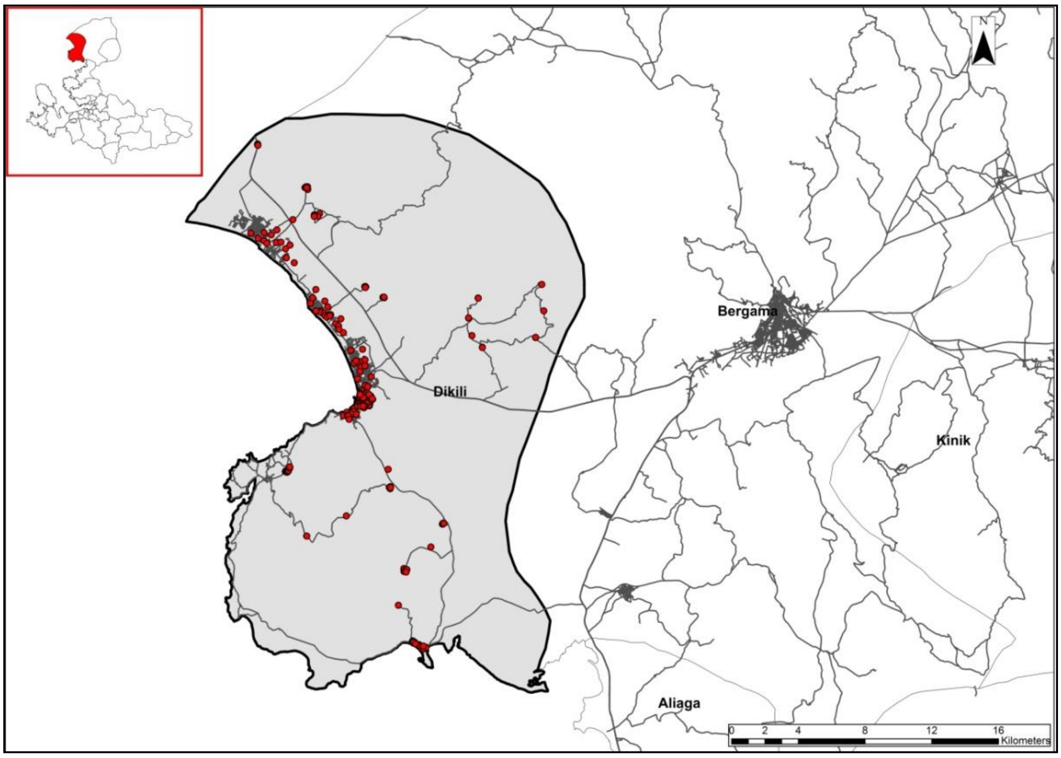

Figure A.10. Dikili

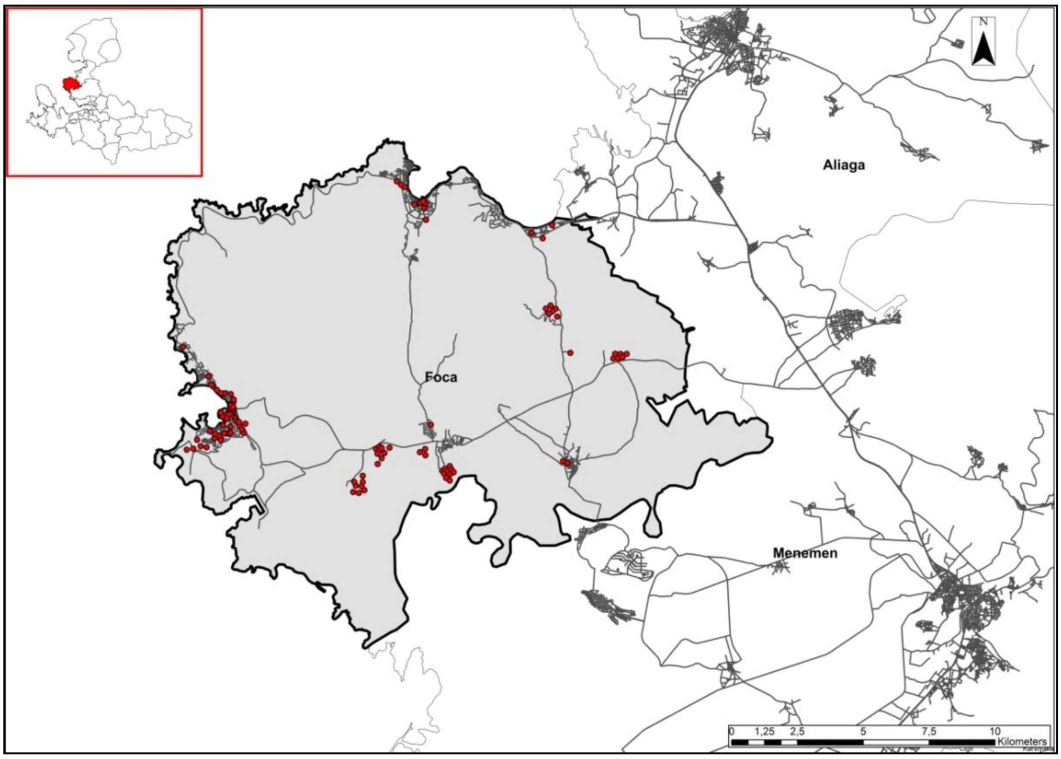

Figure A.11. Foca

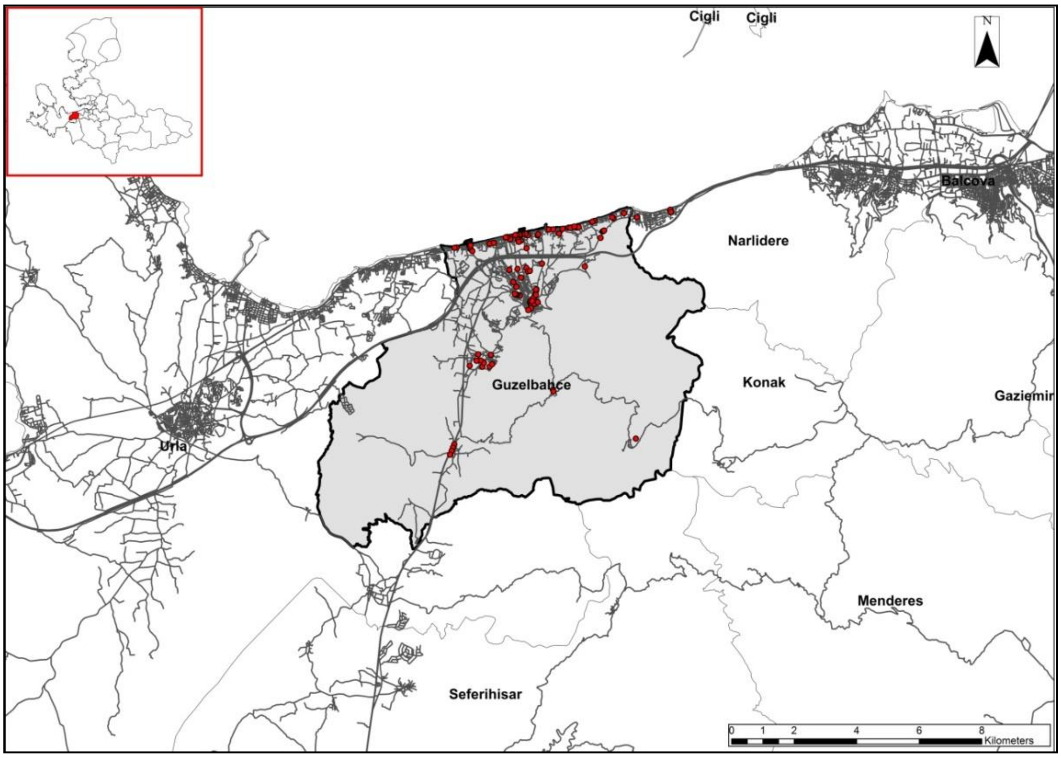

Figure A.12. Guzelbahce

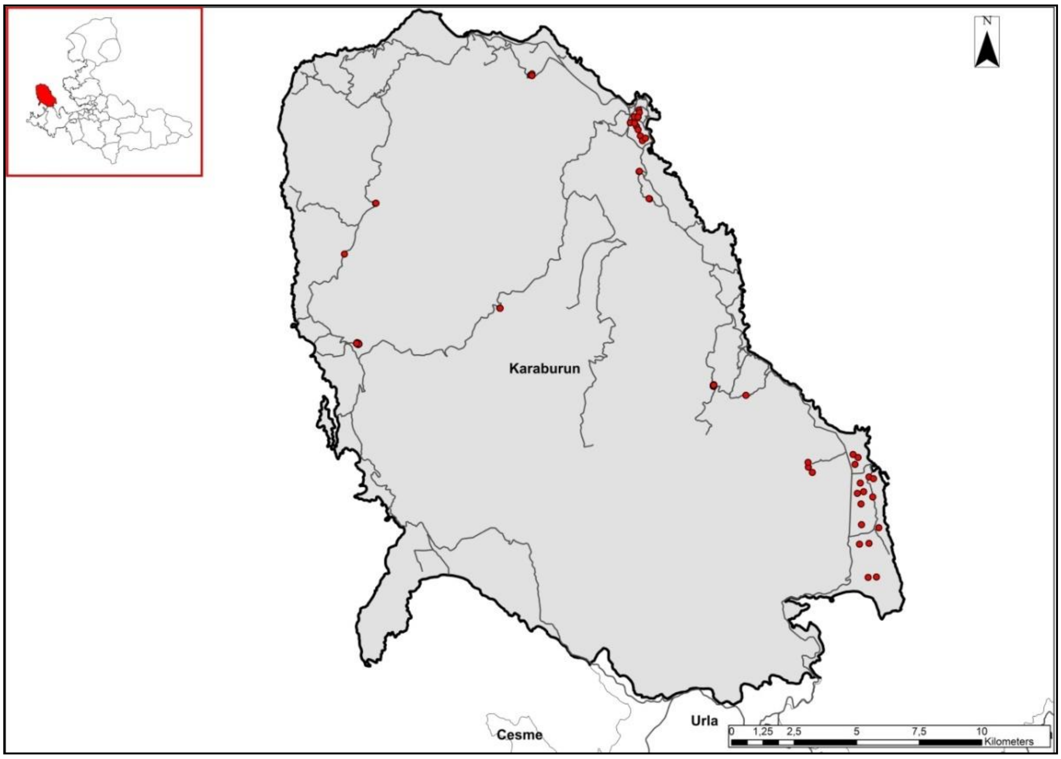

Figure A.13. Karaburun

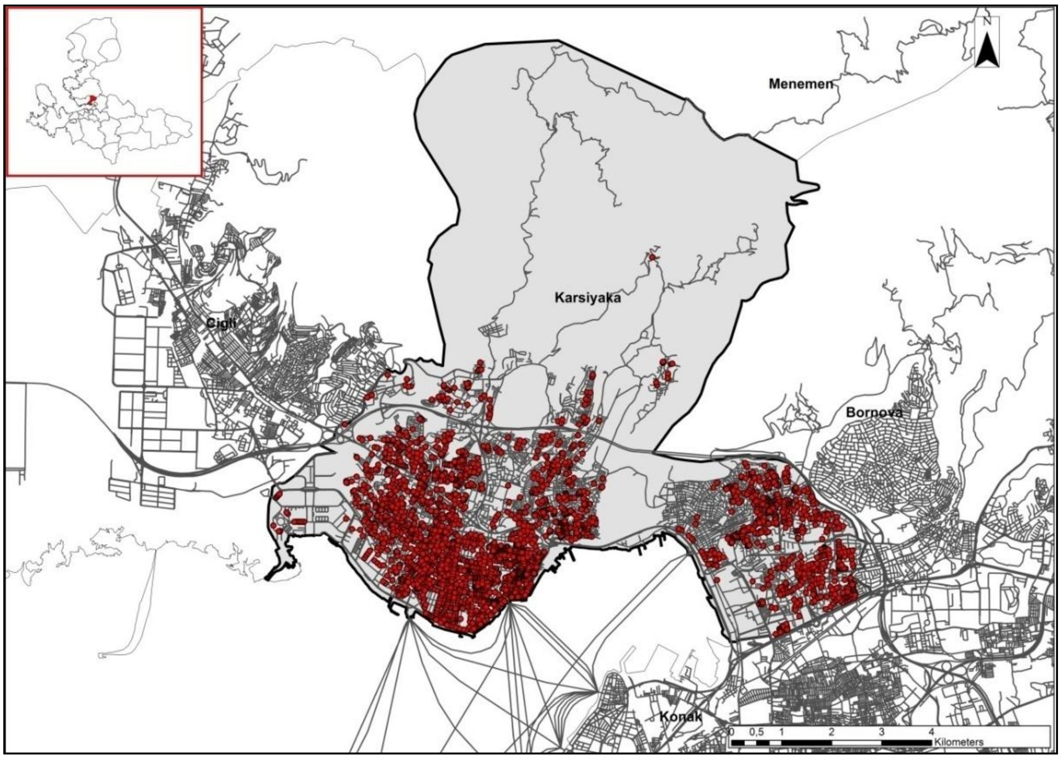

Figure A.14. Karsiyaka

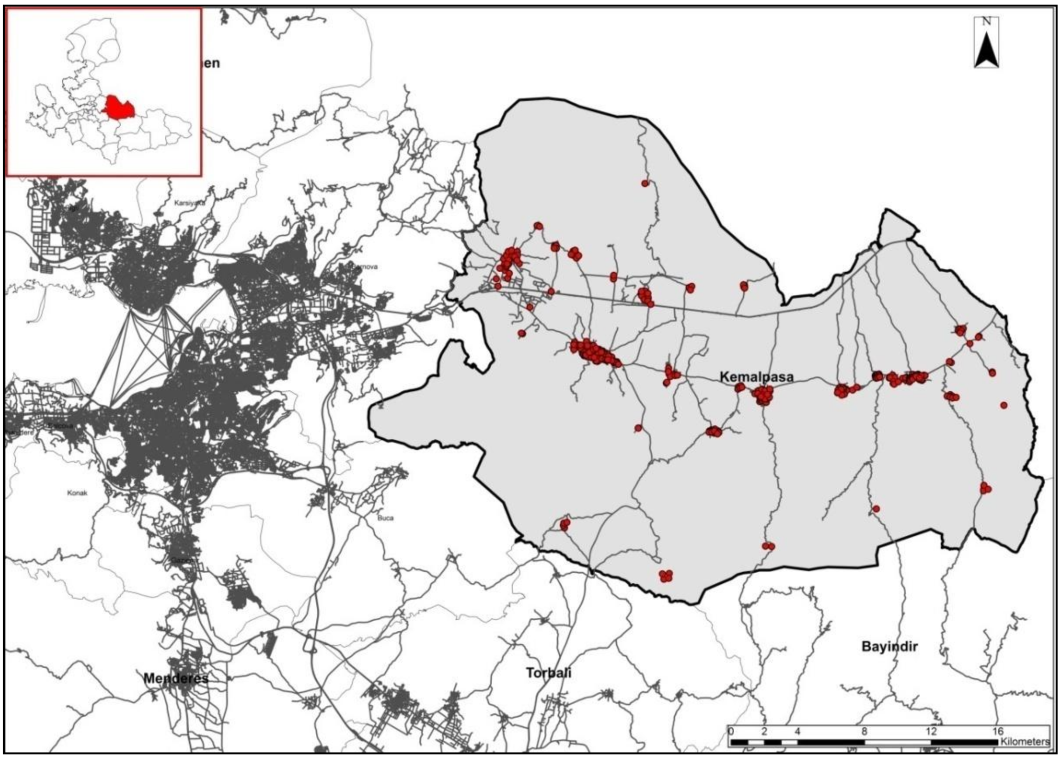

Figure A.15. Kemalpasa

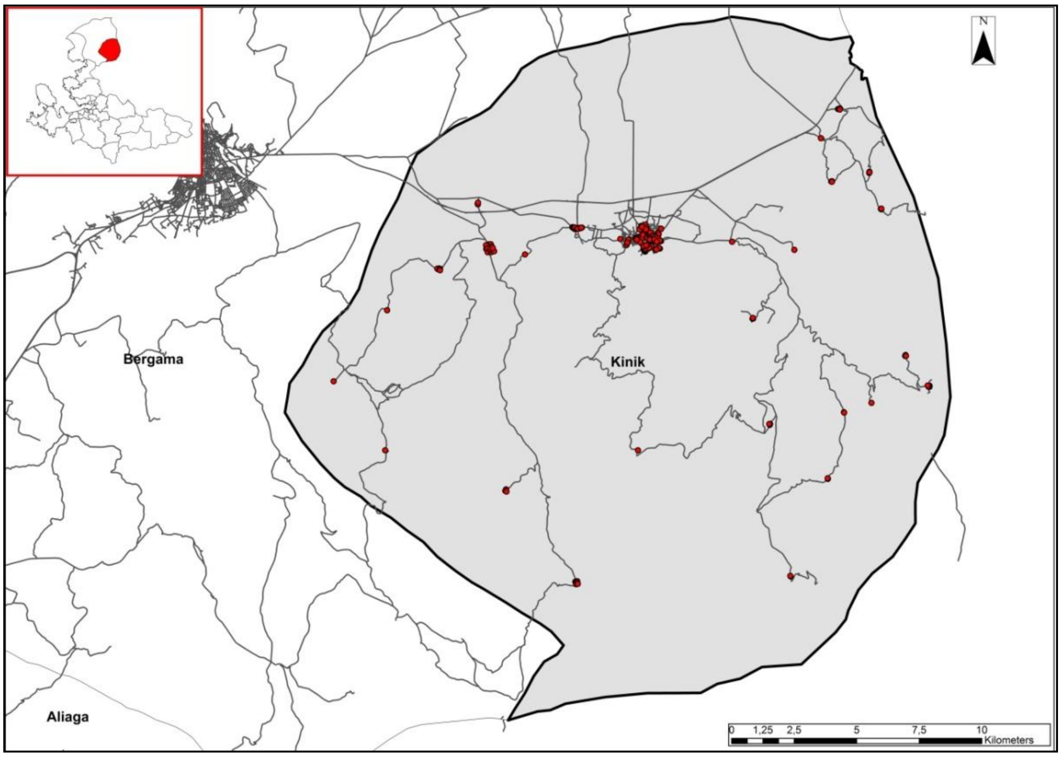

Figure A.16. Kinik

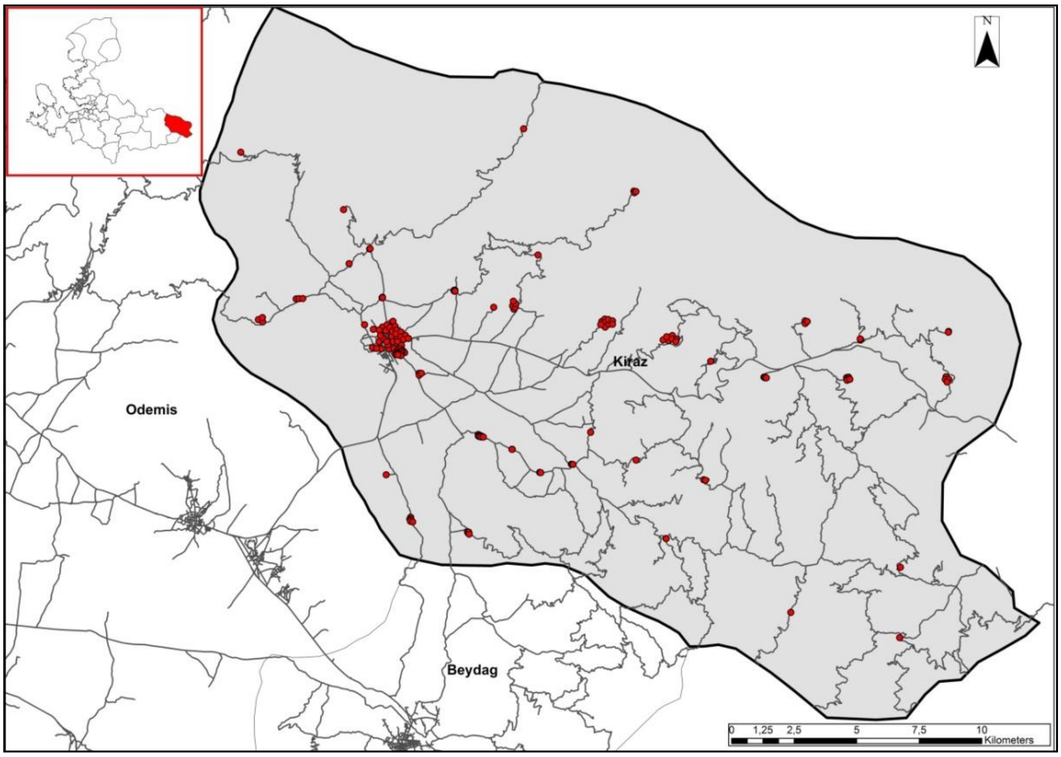

Figure A.17. Kiraz

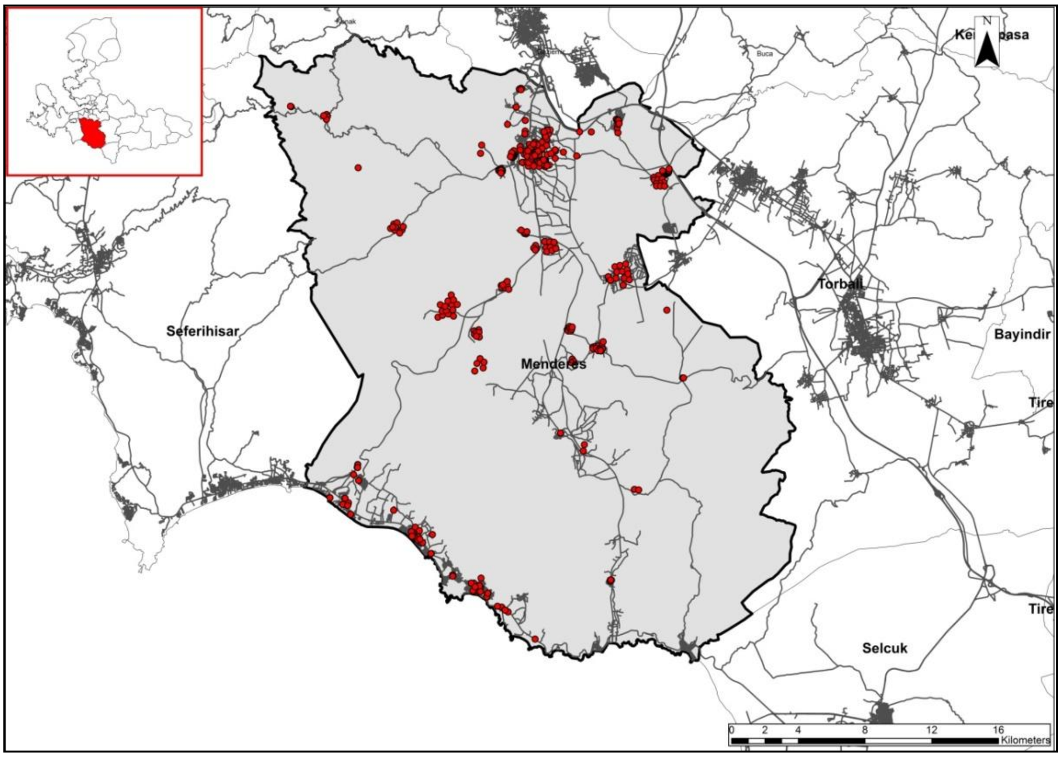

Figure A.18. Menderes

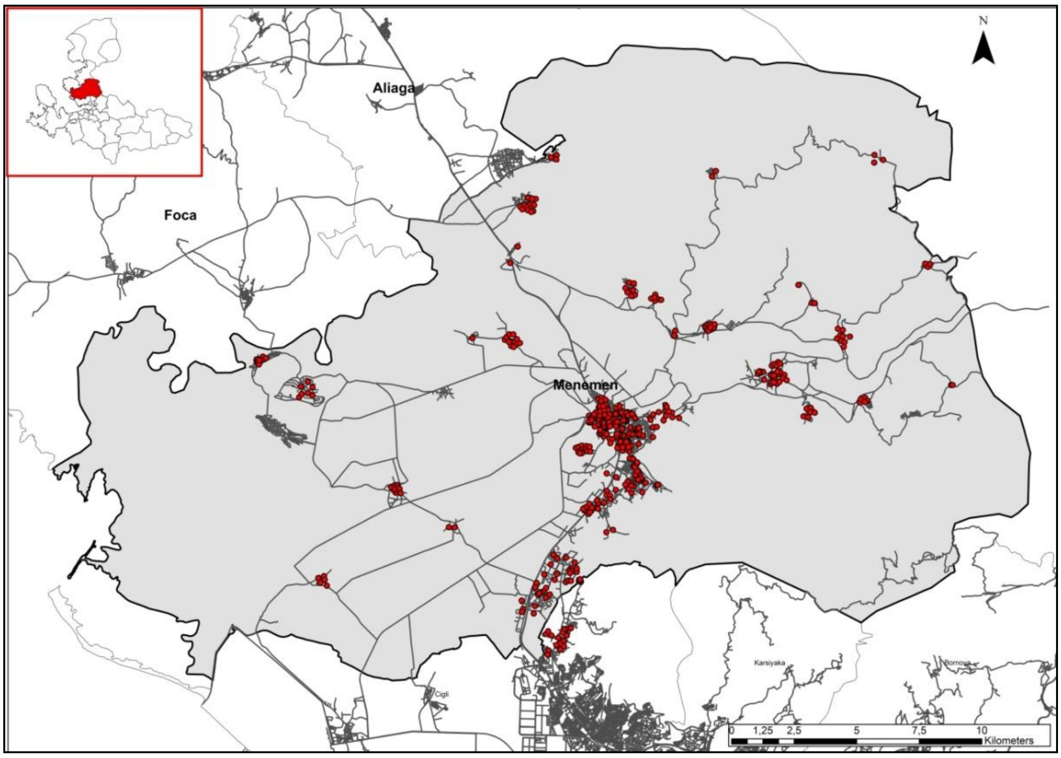

Figure A.19. Menemen

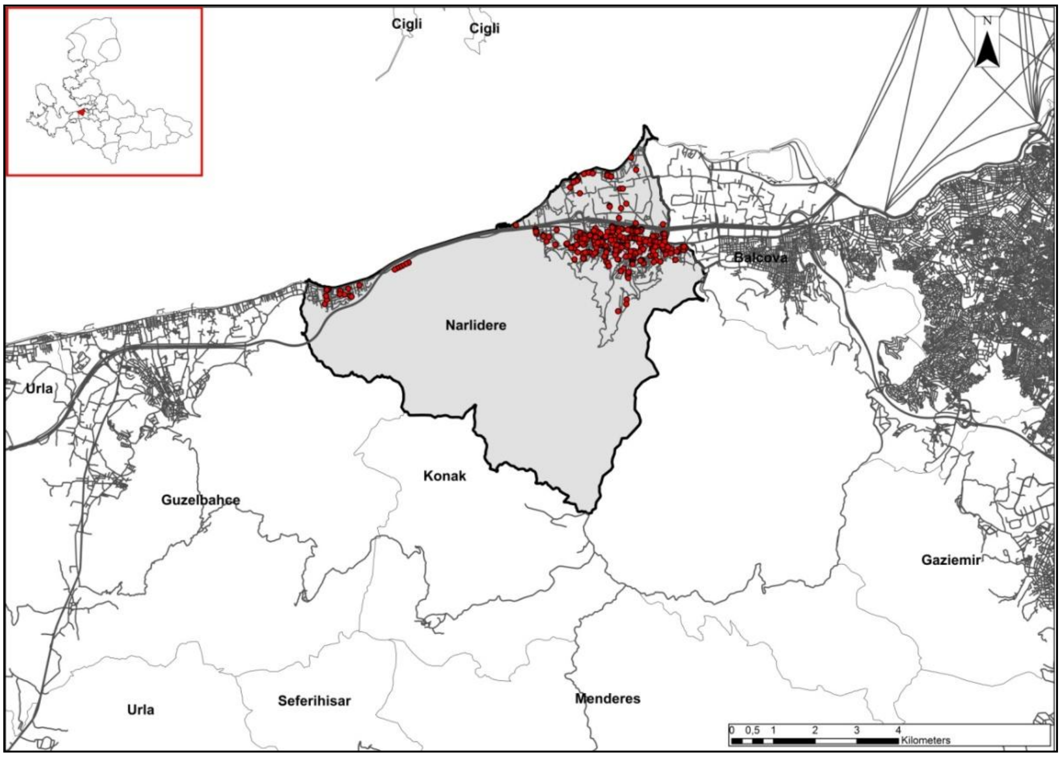

Figure A.20. Narlidere

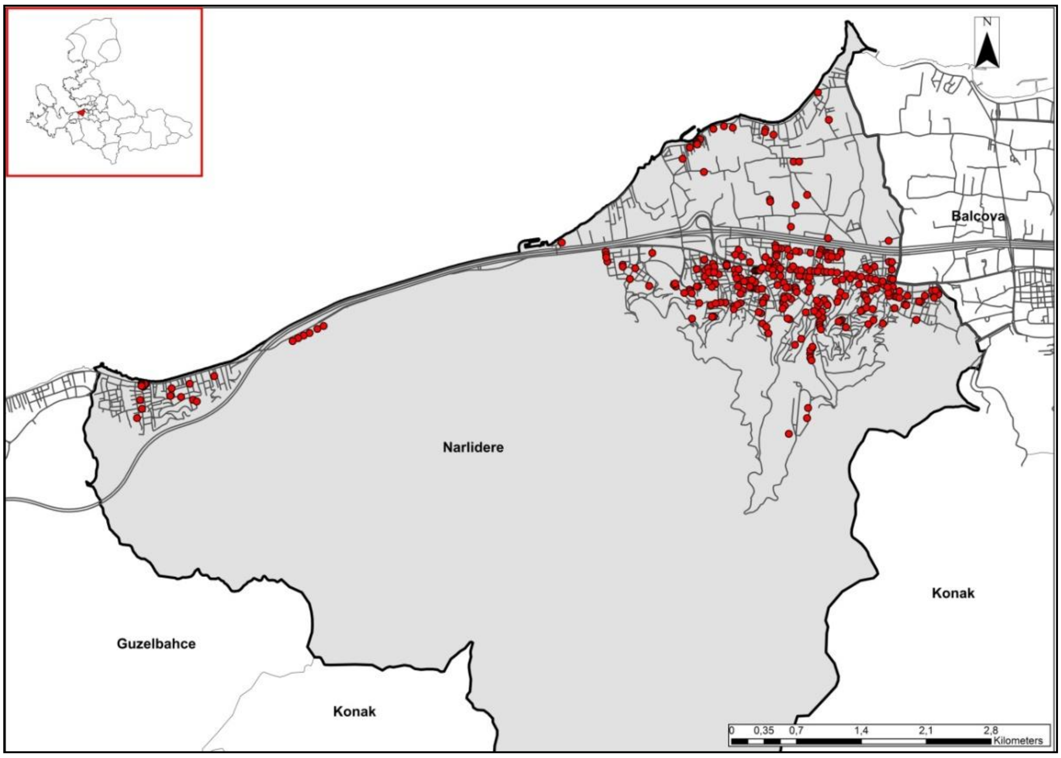

Figure A.21. Narlidere in detail

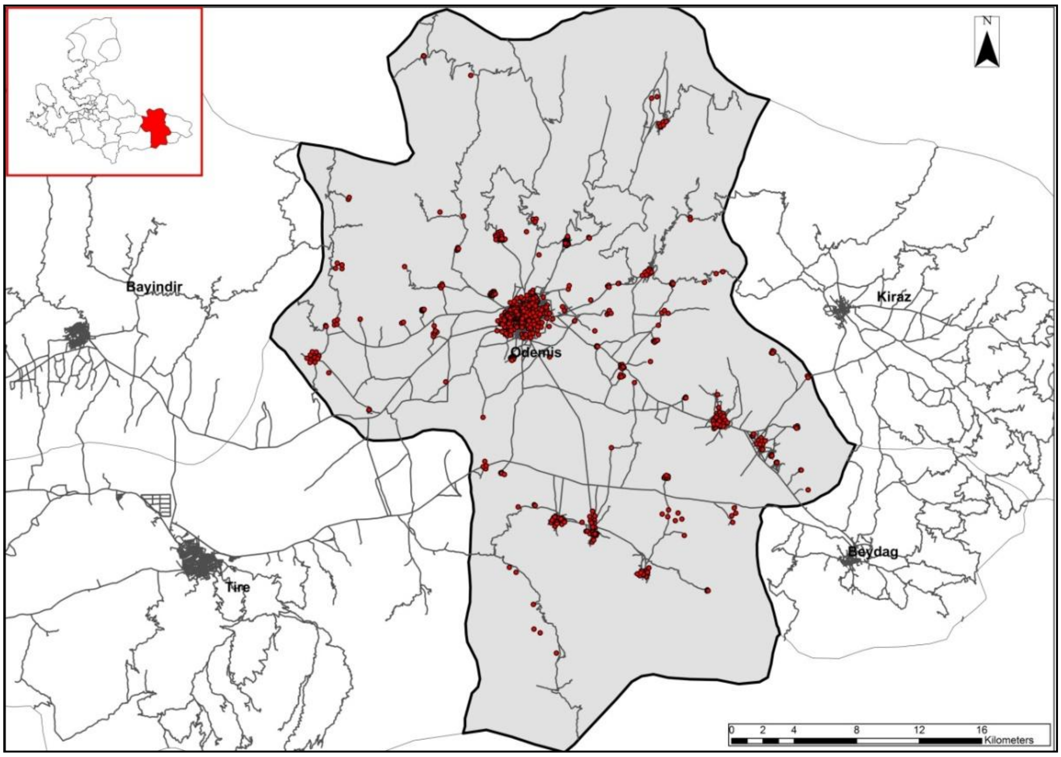

Figure A.22. Odemis

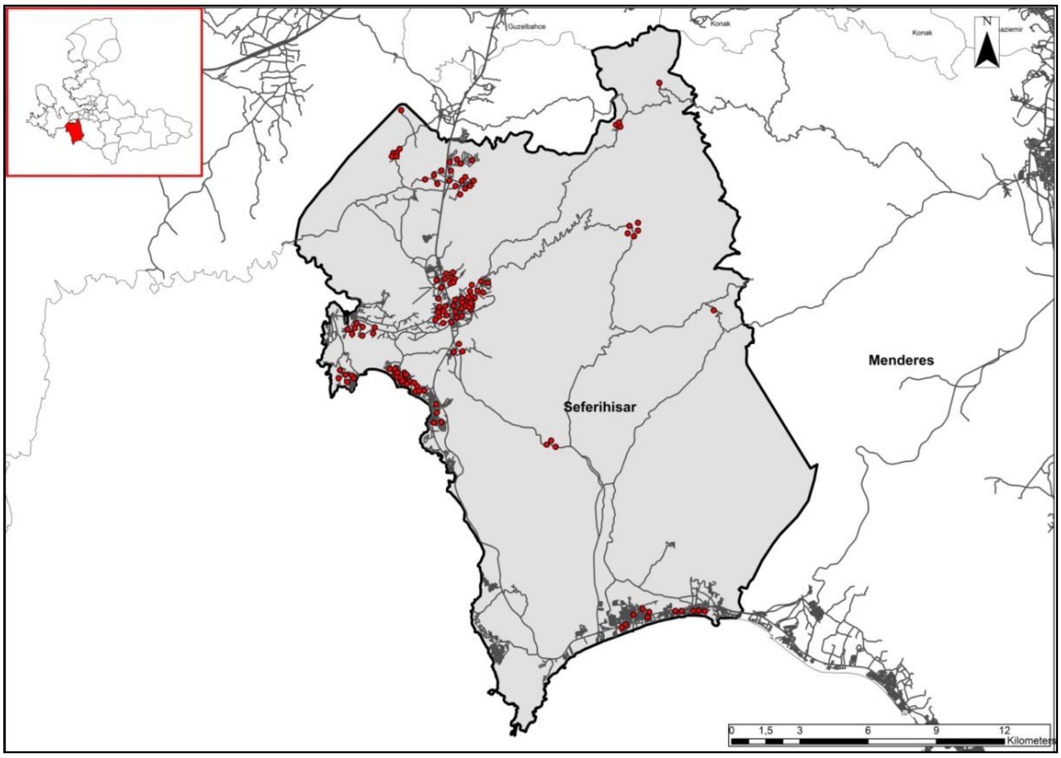

Figure A.23. Seferihisar

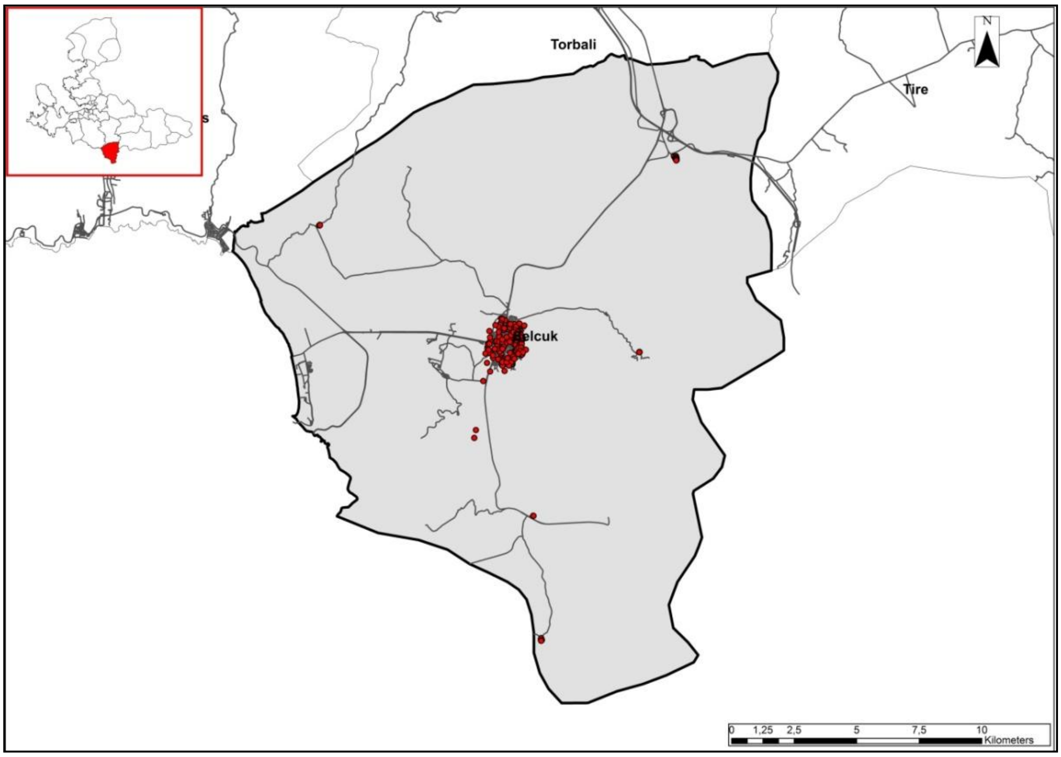

Figure A.24. Selçuk

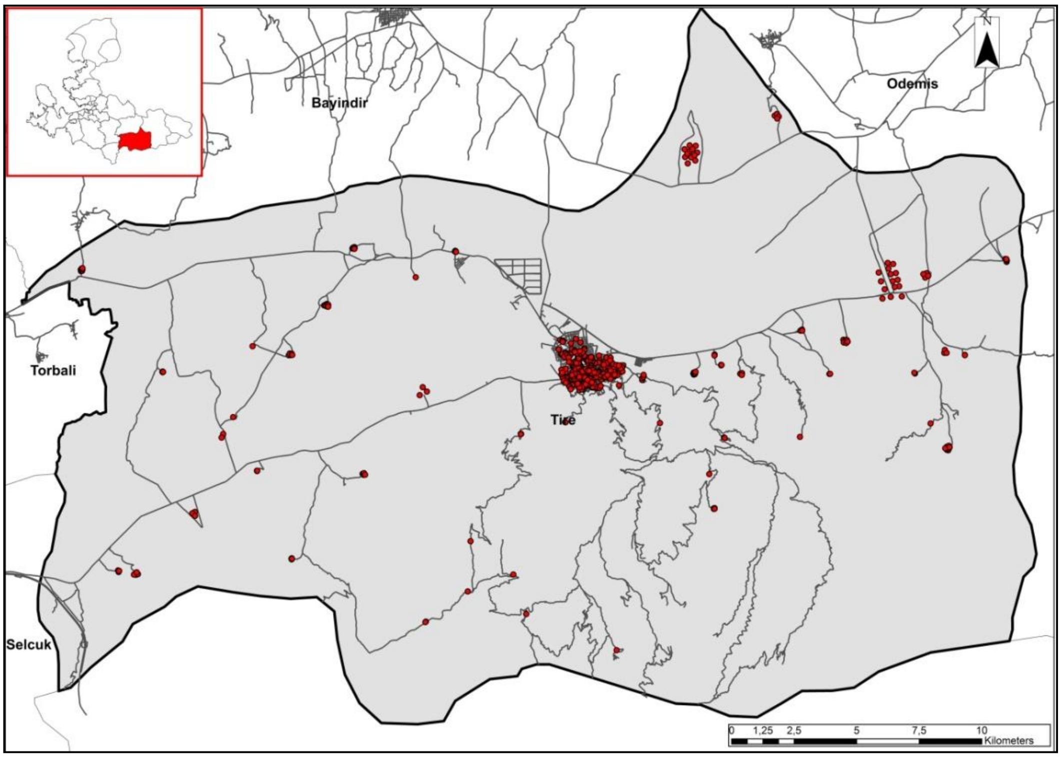

Figure A.25.Tire

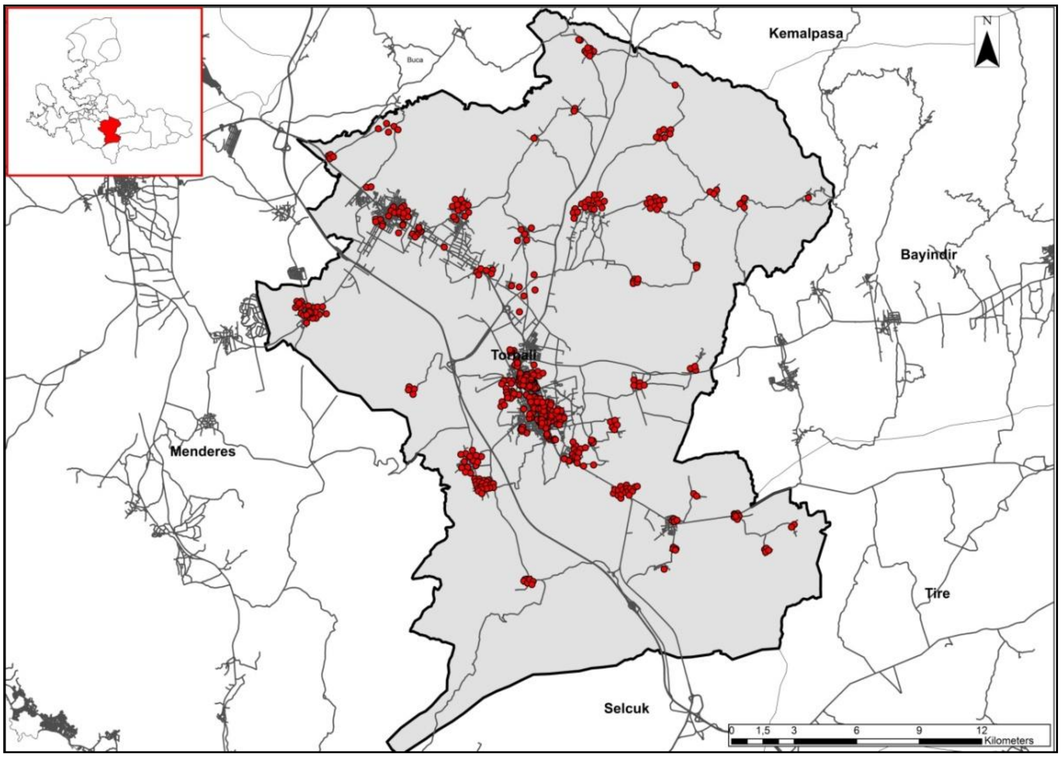

Figure A.26. Torbali