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土耳其健康照護服務可行性: 以地理資訊為基礎之分析

A GIS-BASED SPATIAL ACCESSIBILITY ANALYSIS OF HEALTH CARE FACILITIES IN TURKEY

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摘要

在過去的幾十年裡，醫療資源的可及性已經成為研究人員和政策制定者越來越重要的話題--因為它對人口的健康和健康行為有著重大影響。土耳其人口超過 8300 萬，面積為 783,562 平方公里，是一個獨特的地理環境，可用於研究醫療服務的空間可及性。因此，本論文研究了土耳其全國范圍內醫療服務的空間可及性。它的目的是估計土耳其不同地區，特別是該國農村和城市地區的衛生保健服務的空間可及性有多大的差異。使用兩步浮動集水區（2SFCA）方法對土耳其各省的醫療服務空間可及性進行了測量，考察了人口對醫院、診所和醫生的可及性。這篇論文的結論是，需要更多地關注醫療服務的空間可及性，以確保醫療服務的有效和高效分配，特別是對弱勢人群。

關鍵詞：土耳其、空間可及性、醫療保健的分配、地理信息系統

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Abstract

Over the last decades, accessibility to health care resources has become increasingly important topic for researchers and policymakers – as it has significant impact on health and health behaviors of populations. With a population of more than 83 million inhabitants on an area of 783,562 km², Turkey is a unique geography for conducting research on spatial accessibility to health care. This thesis therefore examines spatial accessibility to health care services in the whole country of Turkey. It aims to estimate to what extent spatial accessibility to health care services varies in different part of Turkey, particularly within rural and urban areas of the country. Spatial accessibility to health care is measured using the two-step floating catchment area (2SFCA) method in Turkey's provinces examining accessibility of the population to hospitals, clinics, and physicians. This thesis concludes that more attention needs to be given to spatial accessibility to health care services in order to assure effective and efficient distribution of health care services, especially for disadvantaged populations.

Keywords Turkey, spatial accessibility, distribution of health care, geographical information system (GIS)

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Chapter I. Introduction

1.01 Background

The world's population is getting older – countries are experiencing a sustained demographic change. The proportion of older people in the world's population is growing dramatically. Following World War II, the period of high fertility in the United States and other nations (e.g. the postwar baby-boom) has significantly affected demographic structure of countries (Doepke, Matthias; Hazan, Moshe; Maoz, Yishay, 2015). The number of people aged 65 and over was 727 million in 2020; the United Nations projects it will continue to grow and surpass 1.5 billion by 2050. The share of older people in the global population is estimated to increase from 9.3 per cent in 2020 to 16.0 per cent in 2050 (United Nations, 2020). European Commission also highlighted that with a rapid expansion in the number and share of older people, the aging of the EU's population will quicken in the coming decades. The number of people aged 65 and over living in the EU-27 was 90.5 million at the start of 2019, and it is expected to follow an upward path and to reach 129.8 million by 2050 (European Commission, 2020).

The worldwide demographic changes are likely to have profound impacts on long-term social, economic, and political fabric of populations. Not only individuals but also governments are facing a variety of challenges as a result of this substantial demographic change. As populations around the world become older than ever before, policies such as healthcare, labor markets, pensions, and social protection need to respond challenges and needs of aged populations. Healthcare systems are changing and expected to change to provide not only equitable care for all but also comprehensive, efficient, and quality of care to populations across the world. Nevertheless, many countries still lag behind the developed world concerning developments on health care.

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In recent decades, health care has become a significant policy for governments. Governments have been devoting more resources and a greater share of GDP on health spending in order to improve life quality of citizens. For instance, in the U.S., the amount spent on healthcare has increased from 6.9% of the GDP in 1970 to 17.7% of the GDP in 2019 (Kamal, McDermott, Ramirez, & Cox, 2020). Furthermore, health care is important factor to prevent and to manage health problems. It is indeed strongly associated with access to health care services – which is often considered as first and foremost tenet of health care (Lin, Wan, Sheets, Gong, & Davies, 2018).

Providing equal and universal access to health care has been in the agenda of Turkish government for decades. Although Turkey has introduced universal health care in 2003 with the launch of the *Health Transformation Program*, equal access to health care is still a challenge that needs to be addressed in order to increase the health status of overall population. Considering the utmost importance of health care accessibility, this thesis uses Geographical Information System (GIS) to measure spatial accessibility to health care services in Turkey. It examines the concept of spatial accessibility, particularly focusing on the accessibility to health care. First, it offers an overview of the existing literature on the spatial accessibility to health care services, and then it provides information on the past and the future of Turkish health care system. Lastly, it analyzes distribution of health centers facilities in Turkey to estimate disparities of healthcare access and to offer policy options for future developments.

1.02 Research Goals and Motivation

Access is one of the most often used terms in the health care system and the health care policy. And yet the term lacks a clear definition. It had long remained vague and ambiguous, without having a common definition. And yet, in recent decades, the term access became a crucial goal for health care systems in order to fulfill health needs of populations. Therefore, equal access to

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primary health care has universally accepted as an important policy to address needs of populations.

The crucial issue related to access to healthcare is the potential of health care and the use of health care services. Guagliardo (2004) explained these two stages of access as "potential" and "realized" delivery of care. Potential delivery of care refers to coexistence of a needy population and a willing health care delivery system; realized or actualized care exists when overcoming all barrier to provision of health care (Guagliardo, 2004). Access thus consists of stages. The process of moving from potential to realized access has famously categorized into five dimensions by Penchansky and Thomas (1981). They discussed the concept of access and proposed a taxonomic definition of it. They defined the access as the degree of fit amongst consumers and providers of healthcare services, and the concept of access summarizes a set of specific areas or dimensions – which includes affordability, availability, accommodation, acceptability as well as accessibility (Penchansky & Thomas, 1981). The last three are essentially non-spatial, while the first two dimensions are spatial in nature. Availability refers to the number of local service points from which a person can choose. Accessibility is travel impedance (distance or time) between user location and service points. Concepts embodied in these dimensions have been identified previously in the literature. Availability and accessibility are spatial, different than the other non-spatial dimensions (Guo, Chang, Chen, & Yip, 2018). Availability is the relationship between the existing services and needs of clients. Accessibility refers to location of clients and healthcare services (e.g. resources, cost, distance and travel time). These two dimensions are often combined in a well-known term in the literature: "*spatial accessibility*" (Guo, Chang, Chen, & Yip, 2018).

Spatial accessibility therefore represents the degree of fit among the suppliers of the healthcare services and the clients of the health care system (Rekha, Wajid, Radhakrishnan, & Mathew,

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2017). Spatial access to health care plays an important role for health status of populations. The spatial accessibility in this sense has often been revisited in the literature of health care since it facilitates to improve the health care access and to eliminate the disparities of health care resulting from poor health care policies by governments. Spatial accessibility is therefore a multidimensional concept, with a particular importance given to the availability and accessibility of health care services.

The spatial accessibility to health care mainly depends on both accessibility and availability of health centers to populations. Thus, eliminating disparities requires allocating equally sufficient health resources to regions in need of services. In many countries, governments put health care of citizens as a priority in their policy agendas. Equity in spatial access to health services facilitates improvements of health status of populations – alongside with eliminating disparities within and between countries. Determining spatial accessibility to health care therefore provide a guideline for policy makers by addressing disparities on access to health care services. Motivated to address these challenges, this thesis aims to measure the spatial accessibility to healthcare services in Turkey. It attempts to answer following research questions (1) to what extent Turkey's population have access to healthcare services? (2) which areas of the country has limited health care access or insufficient resources? (3) what is the association between the spatial accessibility and demographic characteristics? In order to answer these questions and measure spatial accessibility to health care services in Turkey, this thesis uses the two-step floating catchment area (2SFCA) method in the Geographic Information System (GIS) platform.

1.03 Research Problem and Objectives

Today people are living longer than their ancestors. Life expectancy at birth in the world was 47 years in 1950; it has increased significantly and reached over 74 years in 2020 (United Nations,

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2020). Life expectancy at birth, average number of years a new born expect to live, is 78,6 years between the years 2017-2018 in Turkey (TUIK, 2020). Similar to the rest of the world, Turkey has a growing rate of elderly citizens in its overall population. In the recent decades, Turkey has been experiencing a significant demographic change. The number of people aged 65 and over in Turkey has increased 22.5% from 2015 to 2020. Almost more 9.5% of total population in Turkey is aged 65 and over in 2020 and this number is expected to increase in the future and to reach 16.3% in 2040, 22.6% in 2060 and 25.6% in 2080 (TUIK, 2020).

Increase in the life expectancy at birth is mainly resulted from the development in the health care around the world and it is indeed a success story. Nevertheless, as people are living longer, the number of people experiencing chronic diseases (e.g. diabetes, cardiovascular diseases, dementia) are also increasing and they are becoming one of the main reasons of death among elderly populations, compared to other type of diseases (Gandarillas & Goswami, 2018). Population aging has become one of the most significant challenges of the twenty-first century. It is often regarded as a major cause of upward pressure on health care costs. Although Turkey has made a progress in improving socioeconomic indicators such as mortality, morbidity, life expectancy and income, it is still lagging behind many developed world (Agartan, 2015). Equal distribution of health care is a key factor to ensure not only the urban but also the rural part of the country have access to health care services. It is thus important to estimate spatial accessibility to health care services since improvements can only be achieved by understanding challenges and addressing them with right policy options.

The quality of health care in a country is closely linked to how services are distributed throughout different regions – which is described in literature as spatial accessibility of health care services. Health care systems in this sense should aim to provide a holistic health care planning which

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addresses needs of populations (Dejena, Soni, & Semaw, 2019). The amount of medical services is crucial to assure the patients' travel time to locations of health care providers to benefit medical services (Lu, Zhang, & Lan, 2019). It is therefore important to identify areas which lack health care services, particularly rural areas of countries where there are limited numbers of health centers and greater distances to health services compared to urban areas.

1.04 Overview and Conclusion

Since 2003, Turkish healthcare system has been experiencing a significant transformation as a result of the introduction of universal health care. As the Health Transformation Program (HTP) was launched in 2003, Turkish healthcare system has improved its services. And yet, health care system in Turkey still lags behind developed countries. Hence, in order to effectively assess needs of Turkish population, it is crucial to have a complete picture of spatial distribution of health care services throughout the country. The presentation of health care access offers new insights for the future health care policies in Turkey.

In 2020, the population of Turkey has reached to 83 614 362 and the majority of population today lives in the cities. Turkish Statistical Institute estimated that 92.8% of population was living in urban areas in 2019, this number has increased and reached to 93% in 2020. For instance, 18,49% of Turkey's population (i.e. 15 462 452) lives in Istanbul (Figure 1). The number of people living the rural areas, on the other hand, has dramatically decreased, just under 7% of the population is living in the rural areas in 2020 and it is projected to decrease in the future.

The uneven distribution of the population in Turkey has escalated the disparities in access to health care services, particularly in the rural areas of the country and densely populated cities such as Istanbul. The disparities on the distribution of health care services become a concern among the

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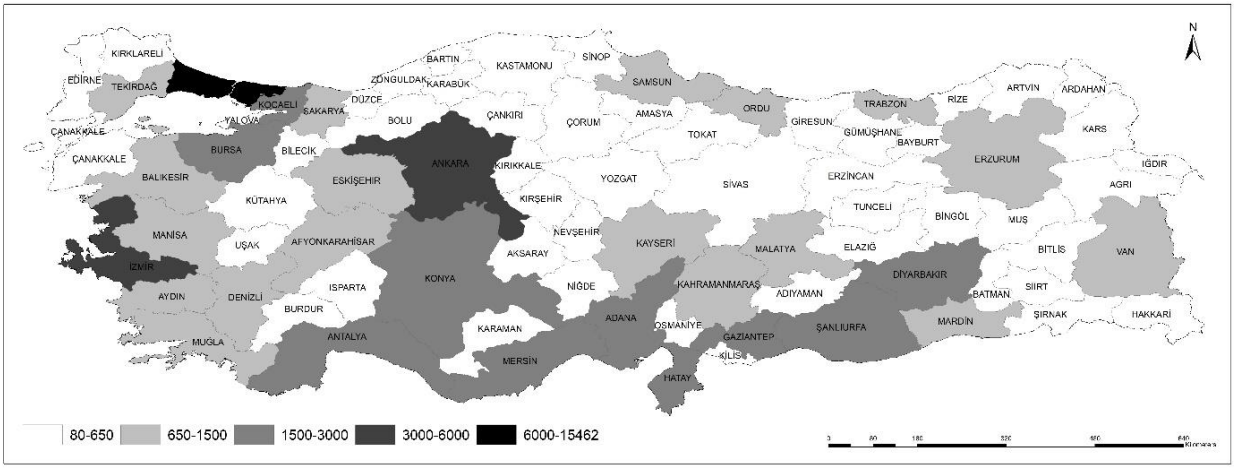

Figure 1 Population data per municipality of the year 2020 (divided by 1000)

public especially after the introduction of the new health care reform in 2003. And yet there is a gap in the literature that indicates spatial accessibility of health centers among different regions of Turkey. Thus, spatial access to health care is still an important policy and research topic in Turkey. In this thesis, the focus in given into spatial distribution of health care services in Turkey in order to estimate disparities in the health care within different regions of Turkey and to offer policy options for future improvements in Turkey's health care system.

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Chapter II. Spatial Accessibility to Health Care

This section aims to provide an overview of the existing literature on distribution of healthcare services and it examines the concept of spatial accessibility, particularly focusing on the accessibility of healthcare. It also gives an overview of Turkish healthcare system, mainly focusing on the period after the launch of the Health Transformation Program in 2003. In 2020, over 727 million persons are aged 65 years or over worldwide (United Nations, 2020). This significant increase in aged population around the world is ubiquitous and it is easily quantifiable. Less known, however, is availability and accessibility of healthcare resources to these increasing number of senior citizens. Analyzing the spatial accessibility of healthcare resources thus became important not only to answer changing needs of populations but also to offer relevant and up-to-date policy options.

2.01 Spatial Accessibility and Non-Spatial Accessibility to Health Care

Health care accessibility is crucial as it exerts significant influence on health and affects the quality of life, especially of senior citizens. Senior citizens are likely to have poorer health than the rest of the population and they often need to go to hospitals due to age-related chronic diseases. In order to evaluate effectiveness of a health care system, it is therefore important to understand the issue to accessibility within a country. Health care access also prevent death and disease; it improves physical and mental health; and it extends life by improving quality of life (HAPI, 2004). A wide variety of contributions has been made by researchers on the accessibility of healthcare within different parts of the world. In this sense, using different methods and perspectives, researchers represented the role of neighborhood as a crucial factor on the health and health behaviors of individuals.

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The health status of individuals is not limited to availability of and accessibility of healthcare services. Indeed, there are various aspects that have direct or indirect influence on health. And yet this thesis focuses on the role of space and place because, as it is explained in a study conducted by Bell et al. (2013), the place or the neighborhood is an important unit of analysis in order to examine accessibility of health care. Additionally, neighborhood can impact not only health but also health behaviors of residents as it is a geographic unit at which policymakers and researchers consider to make decisions and to enact policies (Bell et al., 2013).

(i) Health Care Accessibility

Over the last decades, researchers addressed various methodological and theoretical advances in the analysis of health, disease, and well-being within the context of geographic research. Contemporary issues concerning the geographies of disease, well-being, and health have been widely analyzed within the literature of distribution of healthcare services (Kwan, 2013). Nearly all theories of the distribution of healthcare services have included a perception of access to healthcare. As one of the mostly used words in the literature of healthcare distribution, in this sense, access is constantly defined and redefined by researchers. In a methodological exploration, Wang (2012) have provided a review on the issues concerning to disparities on accessibility of health care. He described accessibility as "*the relative ease by which health care services can be reached from a given location*" (Wang F. , 2012). In order to determine accessibility of healthcare services by individuals, spatial and nonspatial factors need to be taken into consideration. Wang explained the nonspatial factors as socioeconomic and demographic variables including income, age, gender, race, which interact with spatial factors. A well-known definition of the term access is made by Penchansky and Thomas (1981) and they have described the quality of access in five dimensions: availability, accessibility, affordability, acceptability and accommodation. While the

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first two dimensions are spatial, the last three are essentially non-spatial dimensions of access (Penchansky & Thomas, 1981). Availability refers to the number of local service points from which a person can choose. Accessibility is travel impedance (distance or time) between user location and service points.

Similar to Penchansky and Thomas, Fortney et al. (2011) offered a recent, up-to-date definition of access and they explained access as a combination of various dimensions which offers an understanding of the relationship between the patient and the healthcare system. Thus, access has district and yet interconnected dimensions: temporal, geographical, financial, digital, and cultural (Fortney, Burgess, Bosworth, Booth, & Kaboli, 2011). The temporal dimension of access is the opportunity cost of the time that is required to receive services. The geographical dimension of access refers to consumers' ease of travel to healthcare provider which plays an important role in the areas where number of providers are limited such as rural areas. The financial dimension of access simply presents the cost of healthcare services such as insurance premiums, out-of-pocket costs, eligibility, and opportunity cost. The digital dimension of access refers to the connectivity or communications between customers and providers. The cultural dimension of access refers to health services acceptability which includes communication barriers such as language. Thus, according to Fortney et al., measurement of access should include these dimensions of access.

Another important issue concerning access to health care is the potential of health care and the use of health care services. Guagliardo (2004) described access as "potential" and "realized" delivery of care. While the potential delivery of care refers to coexistence of a needy population and a willing healthcare delivery system; realized or actualized care exists when overcoming all barrier to provision of healthcare (Guagliardo, 2004). Penchansky and Thomas (1981) also analyzed the process of moving from potential to realized access in their five-dimensional definition of access

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– which includes affordability, availability, accommodation, acceptability as well as accessibility (Penchansky & Thomas, 1981). While availability and accessibility are spatial, different than the other non-spatial dimensions (Guo, Chang, Chen, & Yip, 2018). Availability is the relationship between existing services and needs of clients. Accessibility refers to location of clients and healthcare services (e.g. resources, cost, distance and travel time). These two dimensions are often combined in a well-known term in the literature: ''*spatial accessibility*'' (Guo, Chang, Chen, & Yip, 2018).

Spatial accessibility to health care services varies significantly within countries as well as between countries. Thus, it is important for policy makers to address these health care accessibility problems and to improve access to health care services. In order to evaluate effectiveness and efficiency of these health care policies, Yang and Mao (2018) suggest that it is important to look at the pattern of health care accessibility changes over time. In this sense, they analyze spatial accessibility to physicians from 1990 to 2010 in Florida, USA in order to understand changes on the healthcare accessibility over time. They measure the spatial accessibility to healthcare by analyzing how different local factors such as service supply, population demand, and transport infrastructure impact the spatial accessibility in Florida over ten years of time period. They propose a new way to measure accessibility to healthcare, analyzing its temporal change. They further point out that health care accessibility changes over time due to a variety of spatial and nonspatial factors (Yang & Mao, 2018). Similar to health care accessibility definition made by Penchansky and Thomas (1981), Yang and Mao categorized the accessibility into five dimension including accessibility, availability, affordability, acceptability and accommodation. While acceptability, affordability, and accommodation refer to nonspatial factors; spatial factors involve accessibility and availability. While many studies particularly focused on spatial factors to measure health care

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accessibility, Yang and Mao argue that it is important to understand changes in both spatial and nonspatial factors over time since not only the access of health care changes over time but also these spatial and nonspatial factors vary over time (Yang & Mao, 2018).

Another similar approach to health care accessibility measurement is proposed by Ni et al. (2019). They argue that measurement of the accessibility of healthcare services requires a detailed and complex assessment which includes travel behavior of residents particularly in urban areas. They measure potential accessibility to primary health care considering three factors: (1) population demand, (2) services supply, and (3) travel cost between the population and services. They argue that these factors are important to measure access to primary care which provides reliable and accurate information to policy makers and health care services providers (Ni, Liang, Lin, Wu, & Wang, 2019). They determine travel behavior and transportation choices of health care costumers using a travel-mode choice survey, which is based on distance sections in Nanjing. Thus, they provide a new approach to estimate the spatial accessibility of health care in urban areas more effectively and realistically, integrating multiple transportation modes into the exiting accessibility measurement methods such as the two-step floating catchment area (2SFCA) method.

A study by Shi and Starfield (2001) also indicated that the importance of primary health care, physician supply in particular, since it is strongly associated with health status of populations. They examined health disparities among the wealthy and the less wealthy in the United States. Using the state level data from the US population, they analyzed the relationship among mortality rates, income, and primary care physician supply in order to understand how income inequalities affect the health. They thus tried to answer the question how income disparities on income and primary care physician supply affect mortality rates of Blacks and Whites within the US population. Their findings indicated that there is a significant correlation between lower mortality

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rate and higher primary care physician supply. They also pointed out higher primary care physician supply lead to better birth outcome and longer life expectancy (Shi & Starfield, 2001). They therefore concluded that neighborhoods with higher number of the primary care units are likely to have better health status than the others. Their results also confirm that health care accessibility is an important aspect to improve population health and to reduce disparities among population – which is a main goal of health care systems around the world. Similarly, Sampayo (2018) argued that it is crucial to understand the geographical distribution of primary health care services in order to ensure equal access by different groups of the population. She attempts to analyze the spatial accessibility of health care services across Texas in order to estimate areas which has limited access to health care services compared to others. She demonstrates the significance of spatial accessibility compared with the other dimensions (e.g. accommodation, affordability, and acceptability) of the health care access since efficient and effective health care distribution can be achieved by elimination of spatial barriers within population (Mello-Sampayo, 2018). In this sense, Sampayo points out the existing health care disparities across Texas countries. She argues that rural part of Texas, especially in southern and western regions, has been suffering from a deprived access to health care while the urban population enjoys a better access to health care services.

(ii) Neighborhood Effects to Health Care

The 1950s was a start of individualism as a dominant ideology in many industrialized countries and this individualism also led to the absence of attention to how the local environment influences human health (Ellawa, Cummins, & Macintyre, 2002). Since the mid-1990s, there has been considerable interest in the accessibility of healthcare resources and most studies focus on the interplay between where you live (e.g. area of residents) and who you are (e.g. gender, age, social class, race) (Macintyre, 2007). The neighborhoods may influence health in the absence of

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mechanisms such as the accessibility and availability of health services, infrastructure, social support (Pickett & Pearl, 2001). Studies in a variety of countries have shown interactions between individual and environmental factors. In a subsequent work, Pearce et al. (2007) establishes a strong geographical and social relationship on access to health-promoting community resources. Using Geographical Information Systems to calculate geographical access to sixteen types of community resources in New Zealand, they found out that access to community resources is worse in deprived neighborhoods. It argues that there are gradients on health between neighborhoods. Their analysis takes off from the large inequalities in health between neighborhoods in New Zealand – which are ranked according to their level of deprivation. They concluded that access to potentially health-promoting community resources are scarce in deprived neighborhoods relative to that of other neighborhoods. These differences in health are indeed beyond individual-level factors. Thus, Pearce et al. ask how access to neighborhood resources influence health and which factors might actually influence health? They link differences in health to three factors: (a) neighborhood physical characteristics, (b) social characteristics, and (c) community resource access. They argue that the differential access to neighborhood resources causes to the gap deprived and non-deprived neighborhoods.

One of the most widely known explanation of the possible contributor to the disparities of accessibility to health resources is the "inverse care law." Published in 1971, the work of Julian Tudor Hart provides an in-depth analysis on the distribution of medical care in the national health service (NHS) of the United Kingdom. Hart argues that there are significant gradients in the quality or accessibility of medical care in the NHS between social classes. He explains that the resources of medical care should be distributed in compliance with geographical and social differences. He concludes these trends as the inverse care law – "*that the availability of good medical care tends*

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to vary inversely with the need of the population served" (Hart, 1971). Policy agenda in this sense plays a significant role to reduce the maldistribution of medical resources as well as the disparities of accessibility to health resources.

Similar to that of the inverse care law, Macintyre (2007) put forward the concept of *deprivation amplification* - a process in which health and health related behaviors of individuals are likely to be poorer in more disadvantaged environments (Macintyre, 2007). It reflects the idea poorer areas are less likely to receive investments and tend to have less access to healthcare services. Environmental factors, which arise disadvantages such as lack of public transportation, therefore have a great impact on health and healthy living of individuals. Macintyre suggests that the spatial distribution of environmental resources should be allocated based on up-to-date empirical evidence on the socioeconomic needs of neighborhoods, taking into account differences concerning types of countries, resources, and time periods. In her work in Glasgow, Scotland, Macintyre observed patterns of residential segregation and pointed out the differences between countries. For instance, in the USA, residential segregation may be along racial lines than elsewhere. The issue of deprivation amplification is therefore important for understanding the interactions between the environmental and individual factors, particularly for the rural and urban planning (Macintyre, 2007). And yet observations on environmental injustice and the distribution of healthcare resources have gained popularity during the early 1980s. For instance, the Environmental Justice movement brought attention to how the hazardous sites in the USA tend to be in the proximity of poor people and, in particular people of color (Williams, 1999). As a result of these movements, the importance of environment in relation to health has been renewed.

Other studies of accessibility to health resources consider not only spatial but also nonspatial factors in examining accessibility to primary healthcare. Wang & Luo (2005) for instance integrate

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spatial and nonspatial factors to assess healthcare assess in Illinois, the United States. They define the spatial factors as geographic barriers or uneven distributions of healthcare between providers and consumers. They also emphasize the importance of nonspatial factor such as education, income, ethnicity, sex and social class to identify the accessibility to primary health care, particularly within physician shortage areas. This integrated method, they define, is a way of using both spatial and nonspatial factors to help state health departments to improve quality of healthcare services for administrative convenience and the public welfare.

Abdullah A. Khan makes a similar analysis in his 1992 work titled "*An integrated approach to measuring potential spatial access to health care services*." He describes the *potential spatial access* of an area's population to a particular service as the availability of that service in relation to distance variable. Thus, the ideal measures of potential spatial access to health care services should be evaluated by the performance of a health care service system. Access to health care, he argues, should be determined both by the characteristics of the population-at-risk in a specified area and the characteristics of the health care service system. While the population-at-risk refers to health status, income, insurance, and age; the health care service system includes the distribution and the size of health care facilities. These two should interplay and moderated by public policies concerning to health care (Khan, 1992). To this end, governments should adjust their policies and make services available to the public – potential spatial access should be offered to potential users of the healthcare services, as Khan explained.

The availability of healthcare services has often been associated with accessibility to public transportation, how elderly people use medical services in particular. The healthcare needs of the population should go beyond the availability of the resources. Poor and frail elderly people in many societies exists as an invisible population with unmet medical needs (Rittner & Kirk, 1995).

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Today, as the number and the proportion of elderly people increases rapidly across the globe, it is important to assess the needs of elderly men and women and to provide necessary resources.

Residential environments not only shape health but also contribute to racial disparities in health because health resources and risks are socially and spatially structured (Zenk, et al., 2005). It is important to note that there are multiple levels that affect individual health decisions, including broader physical, economic, and cultural environmental, social, and institutional levels. The relationship between environment and obesity, for instance, has been studied extensively within a variety of countries, using a number of different research techniques such Geographic Information Systems (GIS) (Ford & Dzewaltowski, 2008).

The complex system of the environments indeed has effects on people's health. The socioeconomic status of individuals is linked to social and economic policies, and the major determinants of socioeconomic status is a part of the wider environment; these in turn are influenced by the broader macro-environments (Swinburn, Caterson, Seidell, & WPT, 2004). Macro and micro environmental influences determine the prevalence of healthcare accessibility; while macro factor refers to environment of the wider population, the micro is associated with close proximity of an individual (Egger & Swinburn, 1997).

The number of healthcare services should be examined including other factors that impact the problem of distribution. One study by Egger and Swinburn (1997) suggested that there are three main influences on weight gain – biological, behavioral, and environmental. They noted that "*the level of body fat is seen not as a 'set point' like a thermostat fixed on an exact temperature but as a 'settling point' that depends on the net effects of the other components of the model and that changes as they change*" (Egger & Swinburn, 1997). They analyzed obesity in a wider context which requires a complex explanation of risk factors and changes within and around individuals.

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The micro-environmental and macro-environmental factors have significant importance since epidemics have been controlled only after modification of environmental factors throughout the history of public health (Egger & Swinburn, 1997). This type of multilevel analysis however is challenging since it requires a theory of causation in order to explain relationships and interactions between micro- and macro-level variables (Diez-Roux, 1998).

A study in the west of Scotland investigated the associations of individual and area-based socioeconomic characteristics with the distribution of health-related behaviors (Smith, Hart, Watt, Hole, & Hawthorne, 1998). It covered a representative sample from a largely deprived area, including 6961 men and 7991 women in order to analyze the associations of individually based socioeconomic measures and health. It has shown that areas with a high level of socioeconomic disadvantage are likely to be disadvantaged in terms of environmental pollution, leisure facilities, transportation, and social organizations – which influence individual health and mortality. Their analyses have concluded that people living in deprived areas are more likely to have less favorable profiles of cardiovascular disease. There is a strong association between the area-based deprivation indicator and individual social class with respect to several important health outcomes, cardiovascular disease mortality rates in particular. It is important to examine the distribution of health-related behaviors with respect to the area-based deprivation in the places where disadvantaged people live instead of focusing on the individuals who live in these areas. Policies should also pay attention to the characteristics of the areas in order to reduce the degree of inequalities in health and socioeconomic disparities. Investigation of how neighborhood environments influence health is not only of academic interest, it has important policy implications to decrease health disparities and to promote health conditions that shape individual lives (Roux, 2001).

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2.02 Past and Future of Turkish Health Care System

Today, the term health care is enjoying an increasing popularity as a main focus of research, policy agendas, and provision. It has become a significant policy for governments in order to increase the life quality of citizens. Health care is a crucial part of individuals' daily lives. Over the last decades, the world has been experiencing significant changes in the areas of economy, demography, technology and environment – which directly and indirectly affect the health of individuals. These changes urge governments to take necessary measurements in order to overcome the challenges such as population aging. Thus, health care is becoming the center of policy agendas at national and subnational levels in order to respond to these challenges.

Several researchers have also indicated the importance of accessibility to health care as a major factor positively affecting the health status of population. Beasley et al. (2007) for instance examined the role of a strong primary health care system in order to provide efficient and effective health care. They argued that the strength of the primary care system in both resource-rich and resource-poor countries indicates the health status of the population (Beasley, Starfield, Weel, Rosser, & Haq, 2007). Thus, the right policies and practices should be implemented to strengthen the primary care, to improve health systems, and to assure equity in health. Beasley et al. have also suggested that more research is needed to grow awareness the pivotal role of a strong primary care for the health of the world's populations, developing effective and efficient health care policies, providing equal clinical care, and for education of primary health care professionals.

Likewise, Dewulf et al. (2013) pointed out the role of primary health care as a first line of defense and a fundamental right of overall population. In this sense, it is crucial to ensure equal accessibility to primary care for populations. In many countries, policies have been implemented in order to address the spatial gaps between the customers and the providers and to reduce the

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unequal distribution of the primary health care. Dewulf et al. in this sense analyzed Belgian policy initiatives to uncover underserved areas of primary health care and to evaluate the extent of spatial health care accessibility. They aim to analyze the spatial distribution of primary health care shortage areas in Belgium. They also pointed out the effort of Belgian government to improve accessibility to health care such as with a program that awards physicians who settle in a physician zone with a low physician-to-population ratio (Dewulf et al., 2013).

Since 2003, Turkish healthcare system has significantly changed as a result of a comprehensive reform in the health and social security system namely the *Health Transformation Program* (HTP) (Saglik Bakanligi, 2003). The reform aimed to change the existing insurance schemes in order to improve accessibility, quality and efficiency of health care services. The reform also brought some changes in regulation and financing both in public and private sectors (Agartan, 2015).

Prior to the reform, Turkish health care systems included a number of different health insurance schemes, covering only two-thirds of total population. The reform combined all existing schemes and transformed the fragmented health care system into a single-payer system in order to ensure universal coverage (Yıldırım & Yıldırım, 2011). Consequently, Turkey has significantly increased its health expenditures from 74.51 in 2010 to 77.77 in 2020 over ten years (World Bank, 2021). Turkey also experienced huge gains in life expectancy. According to Turkish Statistics Institute (TUIK), life expectancy at birth was 81.3 years for females and 75.9 years for males, 78.6 years on average in the 2017-2019 period (TUIK, 2021). The reform has improved the health status of Turkish population and yet Turkey still needs to improve its health care system to ensure sustainability and to face new challenges such as population aging.

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(i) Reforms on the Turkish Health Care System

Turkey is a unique country located both in Asia and in Europe. The country is divided into 81 provinces and 973 districts with more than 83 million inhabitants (TUIK, 2021). Over the last decades, Turkey has been experiencing a significant demographic change as a result of an increase in numbers of aged population. The increase in the life expectancy have significant effects not only on the demographic structure of the country but also on the health care system.

The improvement in the life expectancy and urbanization have various effects on the population, that an increase in local life expectancy and urbanization population rate leads an increase of elderly in a country (Wang S. , 2020). The improvements in life expectancy and demographic aging is indeed an important improvement. And yet such developments may have implications not only for individuals but also for policymakers. As the populations around the world become older than ever before, governments will have to devote more of their resources to implement necessary policies, for instance, health and social care, pensions, public finances and labor markets. They need to respond the challenges of population aging – as it increases health care costs. Appropriate health policy decisions today play significant role to address the health care of the elderly population (Rechel, Doyle, Grundy, & McKee, 2009).

Since 2003, Turkish health care system has been experiencing a significant transformation as a result of the introduction of universal health insurance. Before the reform, Turkey had a complex and fragmented health care system comprised of public and private providers with three main public providers – the Ministry of Health (MoH), Sosyal Sigortalar Kurumu (the Social Insurance Organization), and universities (Sulku & Caner, 2011).

Erus and Aktakke (2012) described Turkish health care system as segmented since Turkey had different public health insurance schemes with various benefit packages. While active and retired

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civil servants covered by Government Employees Retirement Fund, blue-collar public workers and private sector employees were covered by the Social Insurance Institution. The self-employed were covered by Bag-Kur. A different type of insurance scheme called Yesil Kart also existed for those who are unable to afford health care and it was directly funded by the government (Erus & Aktakke, 2012). Each insurance scheme had varying benefit packages. Erus and Akake noted retired and active civil servants as the most privileged group since they had relatively greater benefits and access to hospitals compared to other insurance schemes (Erus & Aktakke, 2012).

The Health Transformation Program (HTP) was introduced in 2003. Under the new regulations, the Turkish healthcare system has changed and improved access to services within the country (Saglik Bakanligi, 2003). Starting in 2004, the HTP aimed to unify the three different insurance schemes and make the coverage of the schemes the same. The unification was formally achieved in 2008, resulting that the healthcare system became tripartite: Ministry of Health, and private sector and university hospitals. Additionally, Universal Health Insurance (UHI) was launched in 2008. As a result of the policy changes, the efficiency was expected to increase while bringing a decrease to the cost of health care down. The UHI has universal coverage and it provides health care services to everyone living in Turkey. It covers a wide range of services including inpatient and outpatient care benefits. And reform process is still ongoing.

(ii) Turkish Health Care Before and After Reforms

Prior to the HTP, Turkey also had a fragmented health care system regarding the finance, pooling, and contributions. Each insurance scheme had its own system, contribution rates and social insurance deductions. The Social Insurance Organization as a main provider got its sources though the payroll taxes. Each individual insurance member contributed directly, and each insurance institutions had their own internal procedure to get the pooling of funds. After the introduction of

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HTP, Turkey merged all existing insurance services, including the uninsured population, under a single institution - the Social Security Institution. Thus, the pooling of funds is centralized and all contributions are paid into a single institution which channels the payments to the government. Health care providers started to receive their funds through the General Directorate of General Health Insurance.

Over the last decades, Turkey has significantly improved its health care system and health status of citizens. Overall life expectancy for both genders increased. The total expenditure on health care as a part of the gross domestic product (GDP) also has increased between 2000 and 2008. These policy changes have positively affected patient satisfaction (Bakan, Buyukbese, & Ersahan, 2014). However, Turkish health care system still needs to be improved. Compared to OECD countries, Turkey has a relatively low health spending. According to OECD data, the health care expenditure in Turkey was only 4.2 percent of the GDP in 2019 (OECD, 2019).

New policies should be introduced to increase the efficiency and to maintain sustainability of public spending on health. Turkey must aim to invest more on its health care system to improve its health care and to enhance the quality of the services. For instance, Turkey needs to adopt gate keeping system to decrease the unnecessary hospital visit and to reduce waiting times, resulting from the universal health care. Turkey should also increase the number of health care services in rural parts to provide to equal access to health care.

In today's world, policies of governments have been changing in parallel with changes in the demographic structures of population. Health care systems are changing and expected to change to provide not only equitable and accessible care for all but also comprehensive health care to populations across the world. And yet, many countries still lag behind the developed world to achieve the basis of universal health care. Providing efficient and universal health care has been

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in the government agenda in Turkey for decades. With the launch of the Health Transformation Program, Turkey has transformed its system of multiple insurance schemes to a single-payer system to provide a more efficient and equal healthcare services. However, the major challenge is to sustain the existing reforms and to implement new reforms to address new problems such as population aging. New policies also need to be implemented to enhance efficiency and to have similar standards of health care with the developed countries.

2.03 Overview and Conclusion

Today, the growing number of aged populations led to analyze not only environmental factors but also distribution of health care services within and across the countries. Emphasis shifted from neighborhood effects of healthcare services to accessibility of health care services among the different groups of societies. The aforementioned studies support the notion that spatial accessibility impacts probability of contact with the healthcare system. It is clear that the access to health care services has various definitions and is demonstrated as a significant for improving population health (Guagliardo, 2004). The aforementioned studies have also shown the importance of the spatial accessibility in a healthcare system. And yet the crucial issue related to access to health care is how to measure the spatial accessibility. Combined with spatial accessibility measurement, the development of geographic information systems (GIS) has provided easier and efficient ways to examine spatial patterns and processes (Moore & Carpenter, 1999). The next chapter provides an in-depth explanation of different ways to measure spatial accessibility.

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Chapter III. Research Design

Throughout the years, various methods have been developed to better understand and effectively measure the spatial access to healthcare. In this sense, today there is an increasing number of geographic technologies to measure access. This section thus presents research design as well as several approaches to define the spatial accessibility of health care and to assess service shortage areas. It reviews various models which are used to measure spatial accessibility.

3.01 Data and Study Area

Over the past half-century, geographic information systems have evolved continuously and made important contributions to display, retrieve, store and analyze data spatially (Lü, et al., 2019). Anselin and Getis (1992) suggested that the geographic information systems (GIS) goes beyond these basic functions (e.g. input, output, storage, analysis) and it performs numerous techniques of spatial analysis such as location-allocation (Anselin & Getis, 1992). Today, GIS as an effective and efficient technology is used in many disciplines from health care research to environmental analysis.

Furthermore, developments in the technology of Geographic Information Systems (GIS) have enabled researchers to have easier and more efficient measurement of geography and its relation with other aspects of life such as health care. GIS not only allows researchers to study and to analyze big data sets but also carry out studies in realistic settings with the use of sophisticated spatial statistical techniques (Anselin, 1998). GIS has been widely used in the different fields of literature, analyzing spatial accessibility of health care in particular as it provides efficient and effective ways to estimate the spatial accessibility providing several methods of measures.

With a population of more than 83 million inhabitants on an area of 783,562 km², Turkey is a unique geography for conducting research on spatial accessibility to health care. Turkey is divided

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into 81 provinces with a total of 973 provincial districts (Figure 2). The majority of Turkish population resides in province and district centers. As of 2020, proportion of population living in province and district centers has reached to 93% in 2020, with an increase from 92.8% in 2019 (TUIK, 2021).

Figure 2 Study area indicating Turkey and its neighboring countries, 81 provinces, and 973 districts.

Turkey also characterized with its densely populated big cities such as Istanbul with its over 15 million inhabitants (Figure 3). The uneven distribution of population indeed creates administrative challenges for policy makers. It creates barriers to health care accessibility, especially in rural areas of the country. The unequal distribution of health care services hence results in spatial disparities. Measuring spatial accessibility is crucial to understand the disparities in health care and to evaluate effectiveness of intervention programs offered by policy makers (Yang & Mao, 2018). This thesis therefore provides an analysis of spatial accessibility in Turkey.

To estimate spatial accessibility to health care services in Turkey, this study uses the two-step floating catchment area (2SFCA) method. It measures the spatial accessibility to health care based

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on the travel times between health providers and population, using Geographic Information System (GIS).

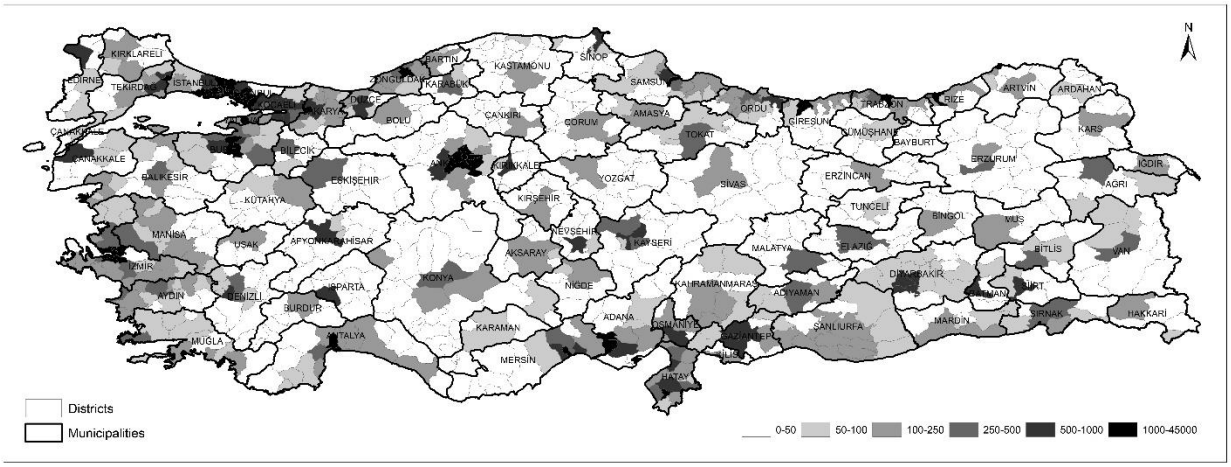

Figure 3 Population density map of Turkey (per square kilometer)

The population data is obtained at provinces and districts level for 2020 from Turkish Statistical Institute (TurkStat). The population data is calculated by considering the records of Address Based Population Registration System (ABPRS) as of 31 December 2020. It was released on February 2021 in Ankara, Turkey (Figure 4).

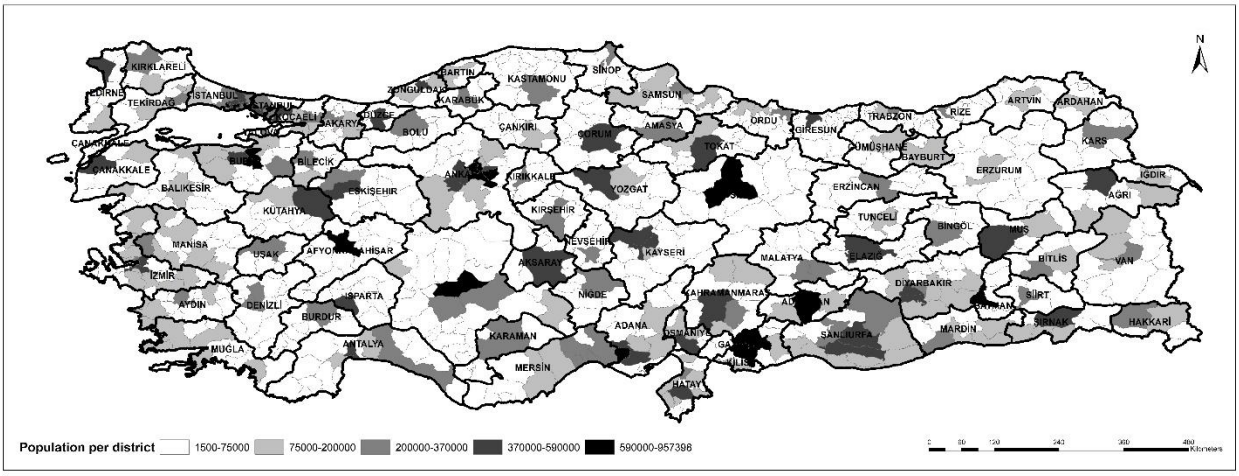

Figure 4 Population data per district of the year 2020

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This research focuses on districts to analyze and interpret availability of, and accessibility to health care services. Turkey has 973 districts and they are established by Turkish Interior Ministry for administrative purposes.

Access to health care has been measured using different methodologies, and this research uses potential access to health care services including doctors, hospitals, and clinics. It focuses on these three types of health care facilities instead of measuring access to primary health since access to the health care do not regulated by a gatekeeping system in Turkey. This research also focuses on the potential access to health care services instead of realized access. The potential access refers to the supply of health care services while the realized refers to usage of health care services. Thus, potential access is an important factor that allows to understand the allocation of resources. The health care services data as well as the road network data of Turkey are acquired from the Humanitarian Data Exchange (HDX) – which is a data sharing platform developed United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA). The data is included doctors, clinics, and hospitals with a total of 1136 active health care facilities in Turkey which is registered as active in 2020 (Figure 5).

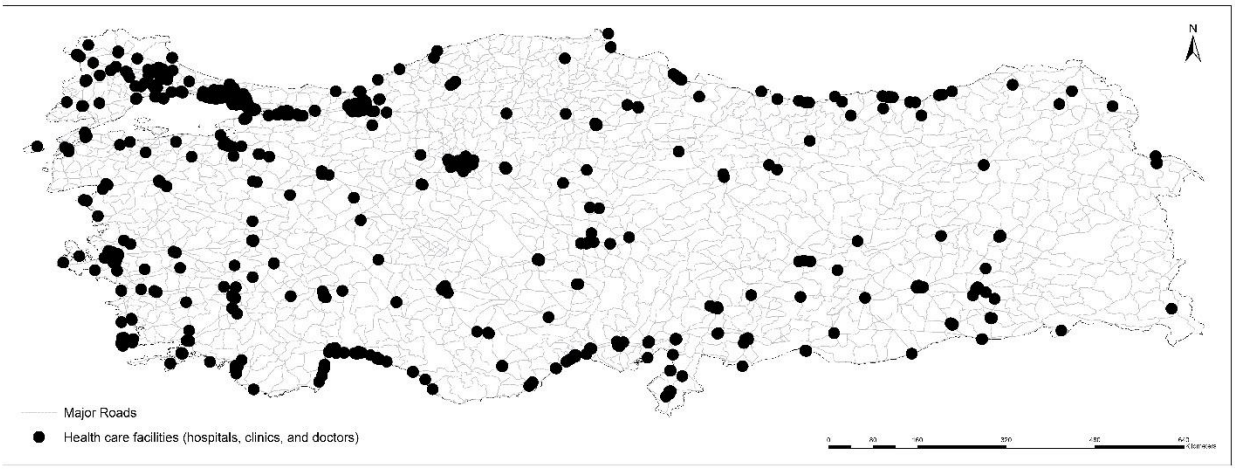

Figure 5 Major road network and distribution of Turkish health care facilities – including doctors, hospitals, and clinics

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The road network is visualized in the Figure 5, which consist of a detailed representation of major roads. Road network data is used to measure spatial accessibility to health care between the providers and the population. The network between the providers and the population is measured using the Origin-Destination Cost Matrix analysis in ArcGIS. The origins are loaded to be health care providers and the destinations are set as needs which are weighted points for each district.

3.02 Measurement of Spatial Accessibility

Spatial accessibility of health care for the population living in rural areas has been a policy concern, especially in the recent decades as a result of increasing migration from rural areas to urban areas, leading a dramatic decline in population of rural areas. Brabyn and Ross Barnett (2004) analyzed the spatial accessibility of health care in the rural parts of New Zealand and pointed out that people living in rural areas have been suffering from two burdens: long travel times and high cost of travel to obtain primary health care. They concluded that improvement of primary health care services is an important requirement to reduce the financial barriers of obtaining the primary health care for the people living rural areas and to increase utilization of needed health care services (Brabyn & Barnett, 2004).

Some researchers, on the other hand, benefited multiple methods to analyze the spatial access in an area. For instance, Dewulf et al. (2013) combined four types of methods to measure accessibility – which include distance to closest physician, physician-to-population ratios, floating catchment area, and cumulative opportunity methods. They used geographical information system (GIS) to apply different methods and to explore how these different methods perform in estimation of health care accessibility in Belgium. They pointed out that the importance of the method that is used to asses spatial health care accessibility since it is not only dependent to but also affected by the methodology used (Dewulf et al., 2013).

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Hence, the spatial accessibility to health care services have been measured with the help of various methods such as gravity models, distance methods, kernel density method, two-step floating catchment area (2SFCA) and extended kernel density 2SFCA methods (Lu, Zhang, & Lan, 2019). Rekha et al. (2017) describes measures of spatial accessibility to healthcare in four distinct categories: (1) *travel distance to nearest provider*, (2) *provider-to-population ratio*, (3) *gravitational models of provider influence*, and (4) *average distance to providers*. Travel distance to nearest provider is a measure of the spatial accessibility which estimates the distance between patients and provider and it is often referred to as travel cost and time. Provider to population ratios or supply ratios measured by the ratio of number of health services such as physicians to number of population size within a specific area. Supply ratio measure does not take the different variations of accessibility such as measures of distance between providers and patients (Rekha, Wajid, Radhakrishnan, & Mathew, 2017). Gravity models measure the potential interaction between providers and patients through combining patterns of accessibility and availability. Average distance to providers, similar to gravity model, combines patterns of accessibility and availability. It measures the travel distance between patients and health care providers.

Lin et al. (2018) on the other hand offered a new categorization of previous approaches to health care access. They described spatial access approaches as (1) single mode approaches, and (2) multi-model approaches – which both offer a more specialized measurement of access. Floating catchment area models (FCA), the two-step floating catchment area model (2SFCA) in particular, are widely used single mode approaches in the literature of access. Lin et al. described the catchment area as the service area which includes both the supply and the demand of services. Float in this sense refers to the boundaries of the services which take place within the catchment area (Lin, Wan, Sheets, Gong, & Davies, 2018).

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KC et al. (2020) also reviewed the approaches on measurement of spatial accessibility and categorized them into four different groups: (1) regional availability, (2) proximity, (3) gravity models, and (4) floating catchment analysis methods. Regional availability refers to ratio of demand to supply within a specific region; it measures the capacity of services compared to demand of population. The proximity measures accessibility based on the time and distance between supply and demand; it is widely used in the literature. The gravity models estimate the interaction between supply and demand considering time and distance factors. Finally, the floating catchment analysis method is more sophisticated method compared to gravity models; and it estimates the spatial access in a specific area to other areas in a specified travel distance and time – in which distant services or supply provide decreasing influence on demand (KC, Corcoran, & Chhetri, 2020).

The study of Fortney et al. also provides an example of methods which is used to measure geographic access to health services in Arkansas. Fortney et al. (2000) used spatial aggregation levels (e.g. county, street, and zip code) and the cost of space calculations (e.g. Euclidean distance, travel time, and road distance) to determine geographic access to health care providers in Arkansas. They assessed the availability of and accessibility of health care services, using a cross-sectional study design. Due to difficulties in developing accurate aggregate proxies of health care access, they measured health care access at the micro-level of the individual, using a Geographic Information System (GIS). They conducted a two-step geocoding of subjects and health care providers in Arkansas in order to measure accessibility and availability to health care services. They used global positioning system, zip code geocoding as well as street level geocoding to assess spatial locations of individuals and providers in their sample. First, they assessed the physical addresses of the subjects and providers in order to determine the spatial locations. Second, the

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travel time and distance between individuals and providers are calculated. In this sense, they defined accessibility as the travel time to the closest provider; the availability is the number of providers within 30 minutes travel time (Fortney, Rost, & Warren, 2000).

3.03 The Two-Step Floating Catchment Area Method

The aforementioned studies offer a reference as well as policy assessment to policymakers when allocating resources of health care services and formulating health reforms. Not only definition of accessibility but also methods used to measure are plentiful, and they have evolved over time as a result of developments on accessibility research and technologies (Bell et al., 2013). Since previously used gravity model has its limitations to measure accessibility, a new method has been introduced by researchers and to overcome limitations of previous methods. The two-step floating catchment area (2SFCA) is more popular method in measuring accessibility. It is created by Luo and Wang in 2003 in order to measure potential access to health care.

Luo and Wang (2003) uses two GIS-based accessibility measures, which are the two-step floating catchment area (FCA) method and the gravity-based method, to examine spatial accessibility of health care services in the Chicago region in 2000. They analyzed primary health care accessibility using the FCA method and the gravity model in order to examine the interaction and the spatial barrier between patients and physicians in the study area. While the gravity model merely considers the accessibility of the health care service provider, the 2SFCA method defines both availability and accessibility of health care services by taking travel time and number of physicians into account. The argue that the 2SFCA method as spatial decomposition method is special case of the gravity-based method and it is easier to use and to measure spatial accessibility since it synthesizes the two methods (Luo & Wang, 2003).

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Taking all these into consideration, this thesis aims to use a geographical information system (GIS) approach to illustrate to spatial accessibility of health care services in different areas of Turkey, and to analyze to what extent spatial access varies in different part of the country, urban and rural areas of the country in particular. Turkey's densely populated urban areas and dispersed rural areas create problems for distribution and use of health care services. This thesis uses two-step floating catchment area (2SFCA) method to measure health care accessibility in Turkey.

3.04 Overview and Conclusion

This thesis investigates patterns of the spatial accessibility of the Turkish population to health care services. It examines the distribution and spatial accessibility of health care service centers in Turkey by using GIS. Data on road networks, population data, and health care service centers (i.e. hospitals, doctors, clinics) are used in order to measure spatial accessibility. Since primary health care plays a crucial role in the health status of population, it is important to address the disparities of health care accessibility to offer a direction for future policies on health care. The main aim of this thesis thus to provide an overview of health care access in Turkey in order to fill the gap in the literature examining health care accessibility in Turkish health care system. It uses spatial analysis techniques in a GIS environment as the methodological approach. The network analysis method in a GIS environment to our knowledge is used for the first time to evaluate access to health care services in Turkey – which can be regarded as the strength of this thesis.

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Chapter IV. Case study: Spatial Access to Health Care in Turkey

Over the last decades, researchers and policymakers have become well aware that accessibility to health care resources has significant impact on health and health behaviors of a population (Bell et al., 2013). This thesis examines spatial accessibility to health care in the whole country of Turkey. Spatial accessibility to health care is measured using the two-step floating catchment area (2SFCA) method in Turkey's provinces examining accessibility of the population to hospitals, clinics, and physicians. This section thus presents research results as well as the two-step floating catchment area (2SFCA) approach to define the spatial accessibility of health care and to illustrate service shortage areas.

4.01 Measuring Spatial Access to Health Care

This study uses the two-step floating catchment area method (2SFCA) to measure access to health care services in Turkey. It defines the search radius as 12 km as a distance that health care customers easily access to available providers in a reasonable time period of 30 minutes which can visualized in the Figure 6. The analysis is conducted using Network Analyst extension of ArcGIS 10.8.1 software and the Origin Destination Cost Matrix tool is used to calculate the travel times.

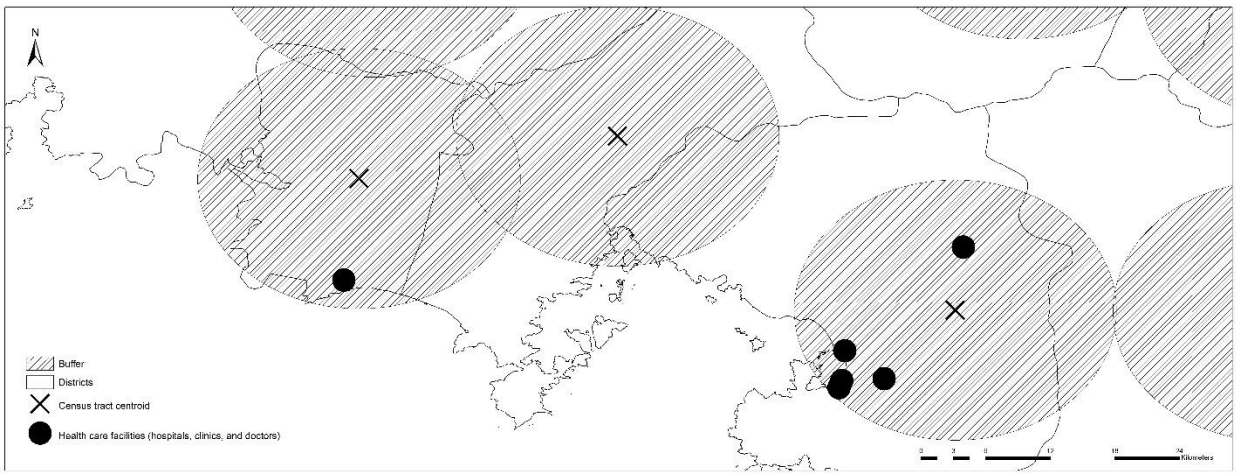

Figure 6 Two-step floating catchment area (2SFCA) method, illustrating 12 km buffer zones

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The first step of this method measures the supply of health care while the second step measure the demand (Vo, Bhaskar, & Plachkinova, 2015). The first step measures a catchment area based on a threshold distance or travel time. Setting a reasonable distance to analyze accessibility to health care both in urban and rural areas is complicated and, in the literature, there is no standard for what this distance should be. Based on the study of Wang and Luo (2003), this research uses a threshold distance of 12 km search radius or 30-minute drive time. Each catchment thus represents travel time or travel distance to health care facilities within the road network that is easily accessible to population. Defining catchments to calculate the provider to population ratio instead of administrative boundaries of each district also enables health care customers to travel across the borders within the catchments. Using the Network Analyst tool of ArcGIS, the provider-to-population ratio is calculated by taking the provider ratios (e.g. health care services) as 1, then dividing it to number of the inhabitants within the services area. In this case, the provider-to-population ratio per 1000 inhabitants is calculated. Each catchment is centered on each district – located on the top of the projected road network. The second step further computes the accessibility by summing up the supply ratio which is provider-to-population ratio of each healthcare provider.

4.02 Health Care Access in Turkey

There is a total of 1136 health care facilities in Turkey, providing services at 973 districts. Based on the classification of services in the database, types of health care services included in the analysis are active hospitals, clinics, and doctors in Turkey; the service points are displayed in the Figure 5. Spatial accessibility to health care providers per 1000 inhabitants is varying in different parts of Turkey. The accessibility ratios classified as low, medium and high – which range from a low of 0 to a high of 1.995. Results are presented by natural break maps with six classes and illustrated in Figure 7.

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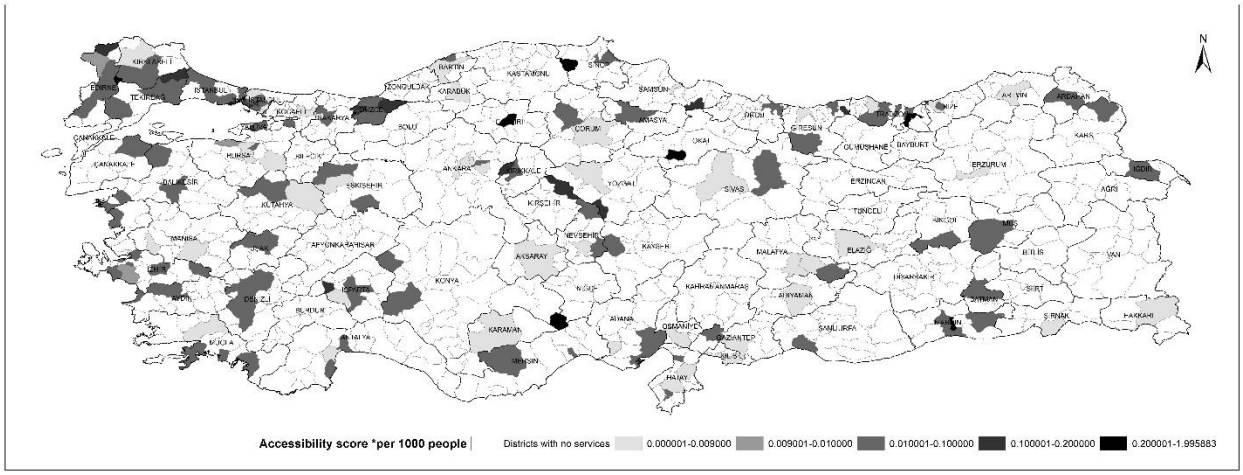

Figure 7 Accessibility to health care in Turkey by the two-step floating catchment area (2SFCA) method (within 30 min)

In all maps, darker shading visualizes higher accessibility ratios while lighter shading represents lower ratios. The district average is 0.016 per 1000 inhabitants. Based on the accessibility ratios, districts are categorized whether they have access to health care or not. The district with a high accessibility ratio to health care are clustered in the western Turkey, especially in the north west of the country, in Istanbul and surrounding cities.

The results reveal a complicated picture of health care access in Turkey. Health care access varies in the different parts of the country and it is clearly not evenly distributed. They indicate that the underserved areas which need allocation of services. The 79 percent of total districts (n=973) are underserved. These districts are identified as health care shortage areas.

Considering the population of Turkey, it is important to increase the number of health care centers within the whole country to assure the equal access to health care both at the district and municipal levels. Of more than 83 million population included in the analysis, 37 056 278 has no access to health care within the distance of 30 km, and 46 050 468 has access to health care in varying degrees (Table 1).

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Table 1 **Spatial accessibility to health care services in Turkey**

	Access		No access		Total
	%	N	%	N	
Districts	20.96	204	79.03	769	973
Population	55.41	46 050 468	44.58	37 056 278	83 106 746

The health care services are crucial part of a society as it has a significant influence on health and the quality of life, especially of senior citizens. But the results of this thesis indicate that access to health care services vary greatly. Nearly half of the Turkish population (e.g. 37056278) has no access to health care services within the distance of 30 km. Majority of health care services are located in the major cities (e.g. Istanbul), so that the rural part of the country has a low number of health care services. The nine of ten districts with the highest ratio of accessibility are located in Istanbul (Figure 8).

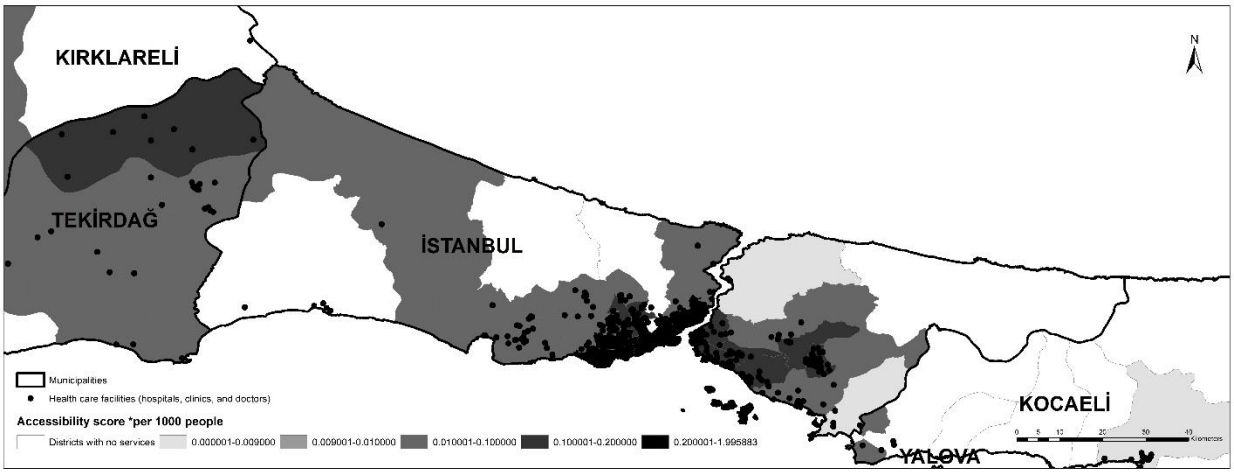

Figure 8 Distribution of health care services in Istanbul and accessibility ratio within 30 km distance

Since the 2000s, Turkey has experienced significant economic growth and social development. As a result of the country's strong fiscal and economic developments, the GDP per capita has

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increased steadily throughout the years (Figure 9). GDP per capita increased from 3 142 US$ in 2001 to 12614 US$ in 2013. In 2020 GDP per capita had an 1.8% increase compared with the previous year. And yet the health care spending still constitutes a small share of the GDP. According to Turkish Statistical Institute, the country has spent only 2.8% of its GDP in education, public administration, social work and human health (TUIK, 2021).

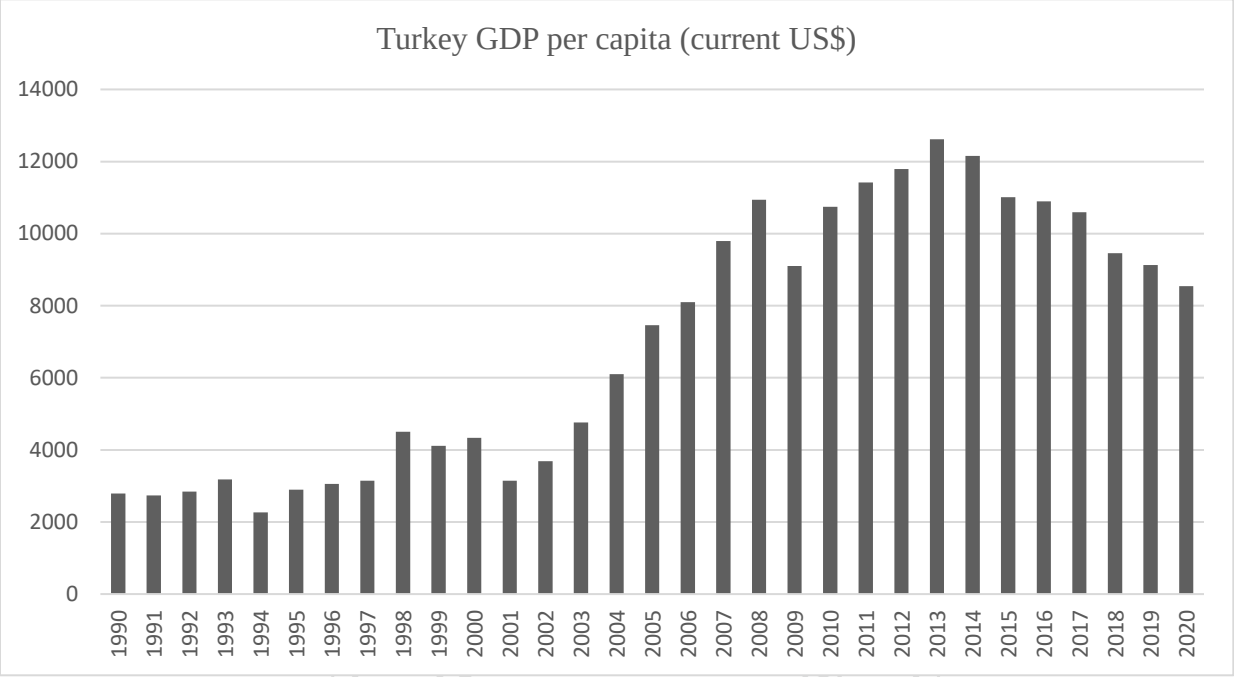

Figure 9 GDP per capita index is calculated according to midyear population. Data are in current U.S. dollars. (The World Bank, 2021)

Furthermore, disparities among Turkish cities indicates the ineffective domestic development policies. In 2019, the GDP of Istanbul was 30.7% of total GDP (TUIK, 2021). The capital Ankara also had a high share of 9.2% (Figure 10). In the estimation of GDP by provinces by the Turkish Statistical Institute, it is clearly stated that 53.7% of total GDP of the country belongs to only five provinces – which include Istanbul, Ankara, Izmir, Bursa and Kocaeli (TUIK, 2021).

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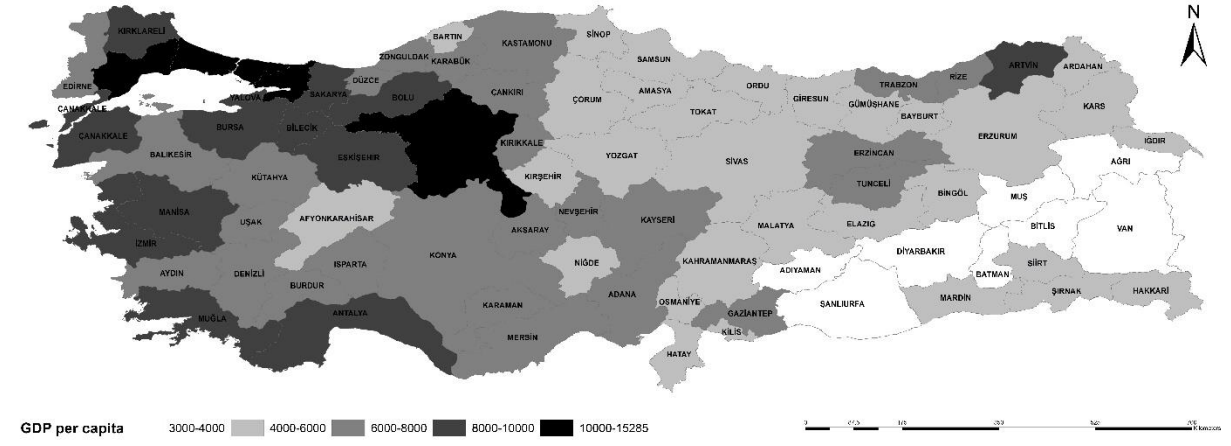

Figure 10 GDP per capita (in US$) by provinces, 2019. Istanbul has the highest share of GDP.

4.03 Neighborhood Determinants of Health Care Access

While it is important to explore the association of the health care access with the economic indicators, it is also crucial to understand possible outcomes of the inefficient health care distribution across the country. One possible outcome of the inadequate health care is lower life expectancy. Since 2000s, the economy of Turkey has seen a remarkable development and life expectancy at birth has increased throughout the years. The life expectancy at birth was 70 in 2000 but it has increased to 77 by 2019 (World Bank, 2021). Although there are many factors impacting the life expectancy of populations, Bhargava et al. (2001) highlighted various determinants such as innovation on health technologies, better sanitation and better public health infrastructure (Bhargava, Jamison, Lau, & Murray, 2001). On the other hand, developments in health care and in life expectancy have influenced the demographic structures of populations leading an increase in numbers and proportions of the elderly populations across the continents. This research thus tries to understand determinants of health care access with analyzing different variables at the national level. It investigates the effects of economic indicator such as the Gross Domestic Product (GDP) per capita and life expectancy on health care access in Turkey.

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Table 2 OLS Regression Analysis				
	Model 1	Model 2	Model 3	Model 4
Health access	-0.02		0.07	0.08
	(.008)		(.24)	(0.19)
GDP per capita		4.73*	4.79*	1.07
		(1.14)	(1.16)	(1.10)
Life expectancy			-0.001	-0.001
			(.003)	(.002)
Population				9.10*
				(1.40)
N	81	81	81	81
Adjusted R^2	0.16	0.16	0.15	0.44
F	17.01	17.01	8.49	22.6
***p < .05 and **p < .01 (two-tailed test).**				

The GDP per capita and life expectancy data analyzed in this thesis are obtained from Turkish Statistical Institute and GDP indicators are based on the US dollars for year 2019. The health access score for each city is calculated based on the mean of access score among the districts. The research further sets health access as the dependent variable while the GDP per capita and life expectancy are set as explanatory variables in order to examine their impacts on the health care access. The ordinary least squares (OLS) regression model is used to analyze relationship between the GDP per capita and life expectancy and health access. Table 2 shows the OLS model. The statistical analysis indicates that there is a positive correlation between health care access score and the GDP per capita by province.

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The results indicate that in each model GDP per capita is positively correlated with the access score and it is statistically significant. When the two variables GDP per capita and life expectancy are considered in the multiple regression (model 3 and 4), life expectancy is negatively correlated with the access score. Nevertheless, the correlation between life expectancy and access score is not statistically significant. In the multiple regression (model 4), including the population variable improves the regression model while increasing the adjusted R^2. The variable GDP per capita also becomes statistically insignificant at both 1% and 5% significant level.

The regression results can also be seen in the scatterplots in the Figure 11, that shows higher GDP per capita is associated with the higher level of access score at the province level. Access score is also correlated with the life expectancy but the relation is not statistically significant across the country.

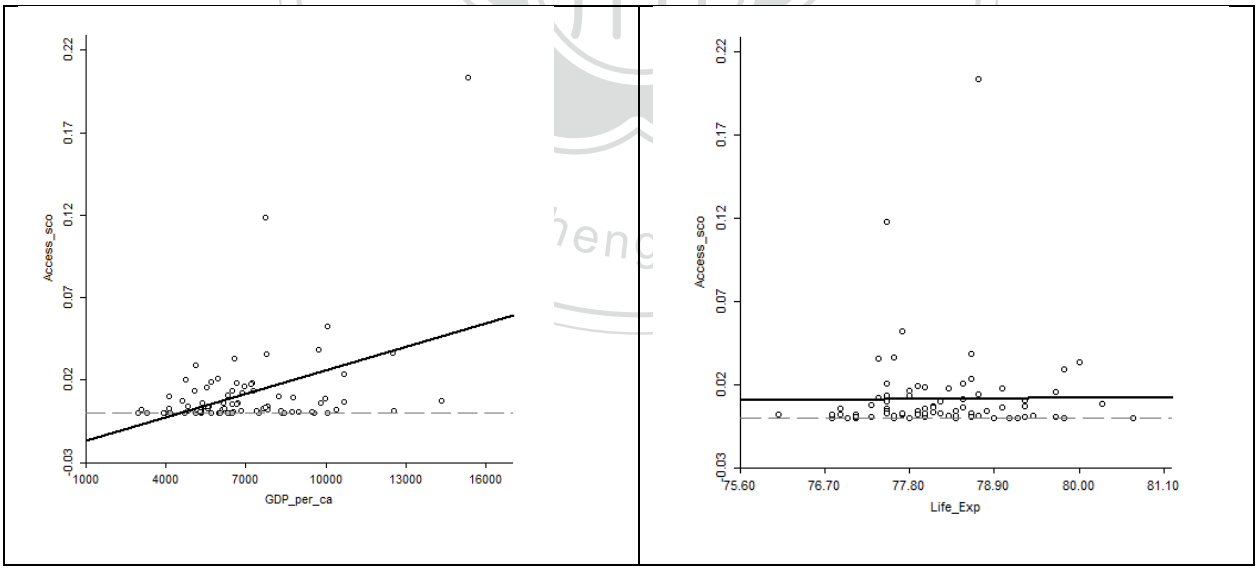

Figure 11 Health care accessibility by GDP per capita and life expectancy

While health care access is a positively correlated with the GDP per capita at the province level, the findings do not offer a causal relationship. There might be other omitted variables that impact

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the health care access. And yet, it is still important to highlight the association of health care access with the economic indicators since higher level of GDP per capita can provide better health care opportunities. This suggests that providing a better economic environment in a society also results in better health care access and health outcomes.

4.04 Overview and Conclusion

The results of this study show disparities of access to health care in Turkey in which a significant amount of the population has limited or no access to health care services within 30 minutes of drive time. The population in the rural areas are disadvantaged considering spatial accessibility to health care. Increasing the number of services in deprived areas is indeed ways to address the problem and providing an even distribution of health care services can help to reduces disparities between rural and urban areas. Greater accessibility to health care also increases the life quality of citizens while decreasing the risk of death especially among the aged population.

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Chapter V. Conclusion

Health care is a continuous and comprehensive set of systems that require to respond the needs and challenges of a changing world. On the whole, life expectancy has increased around the globe driven mainly by the developments on health care. Today people can expect to live longer than their ancestors. The decline in mortality rates is indeed a success story and it is one of the most striking developments of societies at the wake of 20th century. Life expectancy at birth in the world was 47 years in 1950; it has increased significantly and reached over 74 years in 2020 (United Nations, 2020). In Turkey, for instance, life expectancy at birth was 78 years and population aged 65 and older accounts for more than 10 percent of the total population in 2020 (UNdata, 2021). People today are unlikely to die at the young ages. Death is no longer purely adventitious and it is postponed, as John W. Riley (1983) has defined the remarkable decline in mortality. Aging is therefore taking on new meanings for both societies and individuals (Riley, 1983). And these rapid changes of meanings of population aging has resulted in a massive literature.

Population aging that might seem utopian back then is a reality today – which is something to be celebrated but it a progress that needs to be accelerated because today we have more opportunities, and resources (i.e. technological advances). Since the mid-19th century, there has been a significant decline in infectious diseases as a result of improvements such as in sanitation, nutrition, urban congestion and general living conditions (Pearce, 1996). The share of health expenditures is growing globally; for instance, Turkey has increased its share of the healthcare expenditures significantly within the recent decades (The World Bank, 2021). Growing importance of health care among policymakers is transforming societies as well as improving life standards of citizens. Health systems are developing with an increasing focus on primary health care which is also revisited by the World Health Organization in a comprehensive report published in 2008. *The*

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World Health Report highlights the importance of the health care for more equitable, inclusive, and fair health systems and it suggests a fundamental change in understanding of the performance of the health system as a whole (WHO, 2008). And yet there are still inequalities in health, and the disparities between and within countries are continuing to increase. Social institutions have lagged behind to respond the challenges and opportunities of the changing societies. *The World Health Report* also points out a number of trends and problems concerning the health care. It notes that there is a problem of growing health inequalities between and within countries in the progress in health over recent decades. Although many countries are moving forward towards improved health, some countries are lagging behind. Second problem is changing nature of health problems such as aging, worldwide transmission of communicable diseases, ill-managed urbanization. These problems thus require a more integrated and comprehensive health care service delivery. Third, health care systems are not prepared enough to respond the rapid transformation and change; this leads political and economic crisis since the governments are failing to ensure finance, delivery and access to basic health care services across the societies. Furthermore, spatial accessibility of the health care services is often neglected by policy makers.

Over the past decades, academic interest on spatial accessibility of health care is growing, as many scholars have been attempting to understand different aspects of health care delivery. The growing number of senior citizens has been an important inducement to study spatial accessibility of healthcare services. After the introduction of the health care reform, not only the structure of the health system but also the distribution of health care services within Turkey has changed. More research, in this sense, is needed to understand changing structure of Turkish health care system and the spatial accessibility of health care services to evaluate the health care reforms in Turkey. Due to geographic and socioeconomic factors, the spatial distribution of healthcare services in

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Turkey is complex. This thesis thus aims to fill the gap in the literature and to explore the spatial accessibility to health facilities in Turkey.

This research utilizes geographic information systems (GIS) to perform health care accessibility analysis in Turkey. It measures the study area of 783,562 km² with more 83 million inhabitants. It applies the two-step floating catchment area (2SFCA) method to Turkey. While there is the growing number of studies on spatial accessibility to health care, there has been little or no attention paid to health care accessibility in Turkey. This presents one of the strengths of this study. It contributes to literature by conducting spatial accessibility analysis in Turkey. Another strength of this study is that it uses exact location of health care services to estimate the accessibility. It also uses the road network data of Turkey instead of using straight lines to estimate the accessibility in a proximity of a particular population. Instead of analyzing a city or a part of the country, this research also conducts an analysis on the whole country of Turkey, differing from other studies in the health care accessibility literature.

And yet this research has a few limitations – which indicate a clear need for further research on the spatial accessibility of health care in Turkey. One of the limitations is the use of a threshold search radius of 12 km to calculate the ratio of health care providers per 1000 inhabitants. This leads to a simplification because the radius can be higher or lower than assumed number of 12 km or 30 minutes of drive time. The catchment area can also be different in urban and rural areas. For instance, rural areas may need a larger catchment area to estimate accessibility and to have more accurate results. It can also vary depending on the weather, traffic, road condition and location, but such variables are hard to calculate. The second limitation of this research is related to the data. It uses the health care data provided by the Humanitarian Data Exchange (HDX) – which is a data sharing platform developed United Nations and it does not include all of the active health care

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providers in Turkey. Although the health care data does not represent a complete picture of the health care services in Turkey, it includes a representative sample of potential health care services.

Furthermore, this thesis explores the association of health access with the economy at the province level due to unavailability of data. Also, the effects of health care access on a different age groups such as among the elderly population is not analyzed. However, this thesis provides a general picture of the health care access in overall population across the country. It also suggests the Turkish government to provide an open data source where researchers can reach a variety of data to analyze and to understand the needs of the population. This also helps the government to provide better policy options to improve overall well-being of the society. Future work can include a more comprehensive picture of Turkish health care services. It may also take means of transportation into consideration by differentiation people with automobiles and without. Future research can also include nonspatial, socio-economic factors since they can have a great influence on the accessibility to health care.

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