

Health Care Services and the Elderly: Utilization and Satisfaction in the Aftermath of the Turkish Health Transformation Program

Gerontology & Geriatric Medicine
Volume 5: 1–15
© The Author(s) 2019
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/2333721418822868
journals.sagepub.com/home/ggm



Asena Caner, PhD¹ and Seyit Mumin Cilasun, PhD² 

Abstract

With the implementation of the health transformation program, Turkey has gone through substantial changes in its health system in the last decade. This study relies on two nationally representative data sets to investigate health service utilization and satisfaction of the elderly. In particular, it examines the share of elderly who have an unmet need for medical care and who could not afford a medical examination or treatment over the years 2006 to 2015, using data from the Turkish Survey of Income and Living Conditions. It also examines the utilization of health services and satisfaction from these services by the elderly in years 2004 to 2015 using data from the Turkish Life Satisfaction Survey. This study finds that utilization has increased and, coinciding with the introduction of the family medicine system, the percentage of patients choosing primary care facilities has increased. The share of the elderly with unmet need and those who could not afford health care have declined. Notwithstanding, overall satisfaction increased only until 2011–2012. Understanding the utilization and satisfaction of the elderly is important, because along with many other countries, the population is aging in Turkey. In the near future, health care needs of the elderly will have a higher priority on the agenda of policy makers.

Keywords

elderly health, access to health, satisfaction from health services, health reform, Turkey

Manuscript received: July 2, 2018; **final revision received:** November 28, 2018; **accepted:** November 30, 2018

Introduction

With increasing life expectancy at birth and declining fertility, population aging is inevitable in many countries. By 2025, almost two thirds of the elderly population (those who are 65 years or above) will be living in developing nations, which already have an overburdened health care delivery system (Shrivastava, Shrivastava, & Ramasamy, 2013; World Health Organization [WHO], 2018). Turkey, a developing country, is not an exception when it comes to population aging. Life expectancy at birth rose from 66 years in 1990 to 76 years by 2011 (73 years for men and 78 years for women; WHO, 2013). The population share of the elderly, which was 7.5% in 2012, is expected to rise to 10.2% in 2023, 20.8% in 2050, and 27.7% in 2075 (Turkish Statistical Institute, 2015; The World Bank, 2017). Such a substantial change in demographics will eventually require health policy to pay closer attention to the provision of health care services to the elderly.

This article investigates health service utilization of the elderly in Turkey and their satisfaction from these services. There are several motivations behind this article. First, based on the statistics presented above,

population aging in Turkey is expected to increase the pressure on the health care system. Chronic diseases, physical disabilities, and other comorbidities are more common among the elderly (Boutayeb & Boutayeb, 2005). The demand for ambulatory, inpatient, and chronic care is higher among the elderly (Chawla, Betcherman, & Banerji, 2007). For example, in the United States, approximately 80% of older adults require ongoing care for at least one chronic condition, 50% have multiple chronic conditions, and 60% are managing three or more prescription medications (Bates et al., 1995). Second, economic development and urbanization introduce a more sedentary lifestyle and contribute to the onset of noncommunicable diseases (NCDs) such as diabetes and cardiovascular diseases, which used to be

¹Department of Economics, TOBB University of Economics and Technology, Ankara, Turkey

²Central Bank of the Republic of Turkey, Ankara, Turkey

Corresponding Author:

Seyit Mumin Cilasun, Associate Professor/Economist, Structural Economic Research Department, Central Bank of the Republic of Turkey, Ankara 06050, Turkey.
Email: seyit.cilasun@tcmb.gov.tr



more of a developed country problem, but are becoming more common in developing countries (Boutayeb & Boutayeb, 2005). Third, even in the absence of a chronic condition, the elderly need medical care for acute conditions, as well as for extensive preventive care services as recommended by evidence-based guidelines (such as annual influenza vaccination and screening for hypertension, hypercholesterolemia, and many cancers; Calonge, Petitti, DeWitt, Dietrich, & Gordis, 2009; Fiore et al., 2009). The challenge of caring for the aging population has been acknowledged as one of the most pressing health care issues for the 21st century (Knickerman & Snell, 2002). This article depicts a picture of the use of health care services and satisfaction with these services, observing the Turkish health care system as it responds to this pressing issue in the aftermath of a major health care reform.

Many studies document the increased burden of disease and the higher use of health care services with aging (Börsch-Supan et al., 2008; Chawla et al., 2007; Dang, Oxley, & Antolín, 2001; European Commission, 2015; Faruquee, 2002). An assessment of Italy's health system in that respect shows that health expenditure in Italy was mainly driven by an aging population (Lopreite & Mauro, 2017). Aging is presenting countries with the challenge of sustaining economic growth and supporting their older adult populations in the meantime (Bloom, Canning, & Fink, 2010). Supporting elderly population may be particularly difficult, because it requires resources as well as the establishment of social welfare systems that adequately meet the needs of older adults in health insurance, pensions, and long-term care. In many low- and middle-income countries, including Turkey, population aging challenges the welfare system (Lee, Mason, & Cotlear, 2010). The challenges include the promotion of healthy, active, and independent aging; the education and training of health personnel in geriatric care; and the improvement of home health care services for the elderly, all under the constraint of resource availability (Ministry of Health, 2015).

A related issue that the literature focuses on is health care service satisfaction. In a paper that used data from 31 countries and built a satisfaction index showed that satisfaction with the health care system is higher among the elderly than among the nonelderly (Xesfingi & Vozikis, 2016). Similar to the current study, a few studies in the literature focused on both satisfaction and utilization of the elderly (in Saudi Arabia [Mahfouz, Al-Sharif, El-Gama, & Kisha, 2004]; in Dubai [Al Yousif, Hussain, & Mhakiluf, 2014], among Korean Americans [Jang, Chiriboga, & Kim, 2005]). Gümüş and Şahin (2016) investigated the utilization and satisfaction of the elderly from health care services in Turkey using the 2010 and 2012 waves of the Health Survey of Turkish Statistical

Institute (TurkStat), and found that both utilization and satisfaction increased from 2010 to 2012. The earlier years were not studied. The only other paper on Turkey, in the received literature, investigated the rise in utilization from 2002 to 2013 based on province-level data, and the rise in satisfaction based on Life Satisfaction Survey (LSS) data in years 2005 to 2012: Although highly informative, the study misses the most recent years when the trends began to change. Moreover, the article was about the entire population and not the elderly (Hone et al., 2017).

This article contributes to the literature in the following dimensions: First, its focus is specifically on the elderly, unlike the earlier studies that report patterns and trends for the entire population. Second, data from two nationally representative surveys (the Survey of Income and Living Conditions [SILC] and the LSS) are employed to investigate several dimensions of the issue: Unmet health care need, the reasons for not receiving health care when needed, the trends in service utilization, and problems with the services. Third, compared to other studies in the literature (Gümüş & Şahin, 2016; Hone et al., 2017), this study uses a larger data set that covers a longer period of time, which allows one to better observe the changes over time. This contribution is crucial, as the upward trend in satisfaction from health services stopped after 2011-2012. After 2012, patients' complaints have increased in several dimensions: costs and contribution fees, and the insufficiency of the number of doctors.

Turkey experienced major changes in its health care system after 2003. Although causality is not claimed, the data reveal some patterns about the effects of the reforms on utilization and satisfaction. Clearly, an overall assessment of the health reforms in Turkey is beyond the scope of this study.

Background

Since 2003, Turkey has introduced a series of health reforms under the health transformation program (HTP). The program aimed to achieve a widespread, easily accessible and friendly health service system that relied on strong primary health care services, an effective and graduated chain of referral, and administratively and financially autonomous health enterprises to reduce inequities in health financing and in access to health services (Akdağ, 2009; Johansen & Guisset, 2012). The main features of the program were influenced by a policy document of the World Bank. The World Bank (2003) has supported the HTP also by granting loans since 2004 (Yasar, 2011). By 2012, all of the themes have been implemented; however, discussions and criticism continue (Atun et al., 2013; Civaner et al., 2013). The major steps that are directly related to elderly health care are summarized in Box 1.

Box 1. Key Changes to Elderly Health care Initiated by the HTP.

Provision of health services

- The family medicine system: In 2004, the family medicine system was initiated. FPs were contracted by the MoH (Akda, 2009; The World Bank, 2013). An FP, on average, was assigned to 3,629 patients (MoH of Turkey, 2016). The monthly base payment of FPs is adjusted to reflect priorities: Pregnant women and prisoners have the highest payment coefficients (adjustment factors of 3 and 2.25), followed by the elderly and children below the age of 4 years (adjustment factor of 1.6), and finally the general population (adjustment factor of 0.79; MoH, Public Health Institution, 2012).
- Emphasis on primary care: Public health policy assigned priority to improving the quality, efficiency, and effectiveness of primary care services. The Strategic Plan of the Public Health Institution (2013-2017) aimed to increase the share of patients who visit family health centers as the point of first contact to 43% by 2014 and 50% by 2017; to reduce the population per FP from 3,557 in 2012 to 3,437 by 2014 and to 2,954 by 2017 (MoH, Public Health Institution, 2012).
- Investment in infrastructure: In the 1990s and early 2000s, Turkey had the lowest number of doctors and nurses per 100,000 population in Europe (WHO Regional Office for Europe, 2018). Per 100,000 population, the number of physicians increased from 92 in 1990 to 175 by 2014; the number of hospital beds increased from 210 in 2000 to 267 by 2014.

Financing of services

- Creation of a single pool: In 2006, the SSI law (Number: 5502) created a single pool that gathered the entire population under a single umbrella to standardize benefits and liabilities (Baris, Mollahaliloglu, & Aydin, 2011). The pooling mechanism in the previous system was fragmented with three separate statutory health insurance schemes (the Social Insurance Organization—for private-sector employees or blue-collar public sector workers, the Government Employees' Retirement Fund—for retired public employees, and the Social Insurance Agency for Merchants, Artisans and the Self-employed). There were major problems in access to social health insurance. As access was linked to employment, around 33% of the population could be uncovered (Yasar, 2011).
- General health insurance: With the SI-GHI Act (Law Number: 5510) in 2008, Turkey extended health insurance coverage to the entire population. The primary source of funding for GHI is health insurance premiums, which are paid by employers, employees, and the state. Important for this study, pensioners (or their dependents) do not pay any premiums. The premium is paid by the state if per capita family income is less than one third of the legal minimum wage. Those who are neither employed nor a pensioner are covered only if they pay their premiums themselves. The second source of funding is contribution fees. Some services are financed by the SSI unconditionally. For example, all emergency cases, communicable diseases, and preventive care services are unconditionally covered. Important for this study, individuals who are medically in need of another person are unconditionally covered. On the contrary, some services (such as secondary or tertiary care and medications) are subject to contribution fees, even when the case is unconditionally covered. The fees are adjusted annually.

Note. HTP = health transformation program; FPs = family physicians; SSI = Social Security Institution; SI-GHI = Social Insurance and General Health Insurance; MoH = Ministry of Health.

Despite the substantial strides that have been made, challenges remain in the health care system in Turkey. Resources per population are still behind the average for the Organization for Economic Co-operation and Development (OECD); moreover, unequal distribution of health personnel and infrastructure across the country is a major problem (Atun et al., 2013; Ökem & Çakar, 2015; Savas, Karahan, & Saka, 2002; Tatar et al., 2011). For example, according to the Health Statistics Yearbook, in 2015, there were 179 physicians per 100,000 people (131 in the southeastern Anatolia, but 273 in the more developed western Anatolia), whereas the OECD average was 339. The OECD average for the number of hospital beds per 100,000 population was 505 (compare this with 267 in Box 1). The regional distributions of hospital beds and of health personnel such as dentists, pharmacists, nurses, and midwives are also quite unequal (MoH of Turkey, 2016).

Another challenge is that with improved access to health facilities and the performance-based payment system initiated after the HTP, many doctors are expected to see a high number of patients every day. The anecdotal evidence shared in Civaner et al. (2013) revealed that in 2013, it was common among doctors in

a public hospital in Ankara (the capital city) to see 130, 150, 180, or even 230 patients per day.

Materials and Methods

This study used two cross-sectional data sources collected by TurkStat: the SILC and the LSS. In both data sets, the samples were restricted to ages 65 years or above. Detailed variable definitions are presented in Box A1 of the Appendix. The graphical and tabular presentations of descriptive statistics can be seen in the "Results" section.

The SILC is a nationally representative survey conducted annually since 2006. It provides detailed information such as the well-being, income, demographic characteristics, employment status, and socioeconomic conditions of individuals. Samples are selected via two-stage stratified sampling. The sample size takes into account possible nonresponse; therefore, no replacement is undertaken. The interviews are made once a year in April, May, and June (Turkish Statistical Institute, 2014).

Logistic regression analysis was used on the SILC data to control for the effects of individual characteristics on unmet need. Here, the dependent dummy variable was

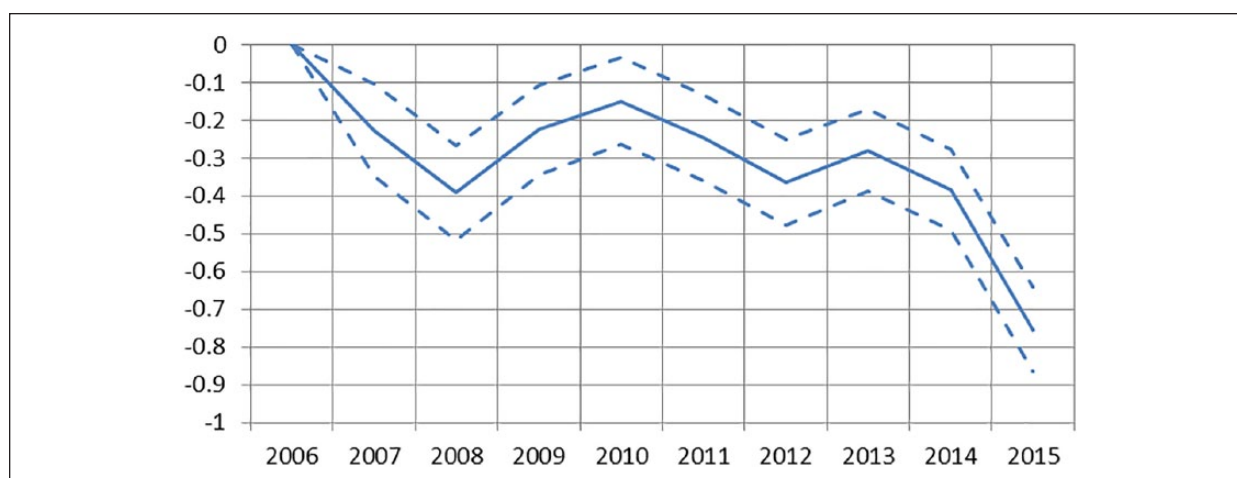


Figure 1. Unmet need for medical examination or treatment over time among the elderly.

Source. Authors' calculations using data from SILC.

Note. The graph presents coefficient estimates and 95% confidence intervals for year dummies from logistic regression. The control variables in the regression are age, sex, marital and education status, real income, self-assessed health, and year dummies. SILC = Survey of Income and Living Conditions.

1 if the individual reports unmet need for health care, and 0 otherwise. The control variables were age, sex, marital, and education status, self-assessed health, real income, and year dummies.¹

The second data source, the LSS, has a cross-sectional nature with independent, nationally representative samples collected each year in November. It provides information on utilization of health care services within the calendar year, satisfaction with health services, the point of first contact when ill, the reasons for the choice of provider, and problems with different aspects of services. Households are selected by two-stage stratified sampling. Data from years 2006 to 2015 are used (Turkish Statistical Institute, 2015).

The LSS data were used to estimate an ordered logistic regression on satisfaction from health services, where the dependent variable varied from 1 to 5 (5 = *very satisfied*, 1 = *very unsatisfied*). The sample was restricted to individuals who used health care services. Control variables were age, sex, marital and education status, real income, year dummies, and satisfaction with own health.²

Results

SILC Results

Descriptive statistics for the elderly in SILC are presented in Appendix Table A1. More than 50% of the elderly are women, whose share increases to 57% in 2015. Around 60% of the sample is married. More than 60% of the sample has less than primary education; only 3% has a university degree.

Because access to basic health care is a human right, it is important to study the answers to the “unmet need” question in the SILC. Figure 1 presents logistic regression estimates of year dummies and the 95% confidence

intervals around the estimates. In general, a downward trend is observed over time in self-stated unmet need relative to 2006, indicating an increase in coverage. In other words, in all years, compared to 2006, a lower share of the elderly reported unmet medical examination or treatment (with 95% confidence). This finding confirms that coverage increased after the HTP. Details of the estimation results are given in Appendix Table A3. The main findings are that women report less unmet need than men, and married individuals report less unmet need than single individuals. Moreover, unmet need decreases with age, education, income, and good health.

Following the unmet need question, the survey asks the main reason for unmet need. The most frequently selected main reason is “could not afford to.” Figure 2 plots the evolution of the percentage of the “could not afford to” answer over time. The share of people who report that “they could not afford the cost of treatment” as the main reason for unmet need exhibits a decreasing trend between 2006 and 2015. The only exception is 2009, when the effect of the global financial crisis was heavily felt in Turkey.

The other main reasons for the unmet need that were reported by the elderly are “Could not take time (because of work, care for children or others),” “Wanted to wait and see if problem got better on its own,” “Too far to travel/no means of transportation,” and “Fear of doctor/hospitals/examination/treatment.” For instance, in 2015, the shares of these reasons were 11.2%, 17.5%, 5.7%, and 4.5%, respectively, compared with 55.5% for unaffordability.

LSS Results

Descriptive statistics for the elderly in LSS are presented in Appendix Table A2. Similar to the SILC sample, more

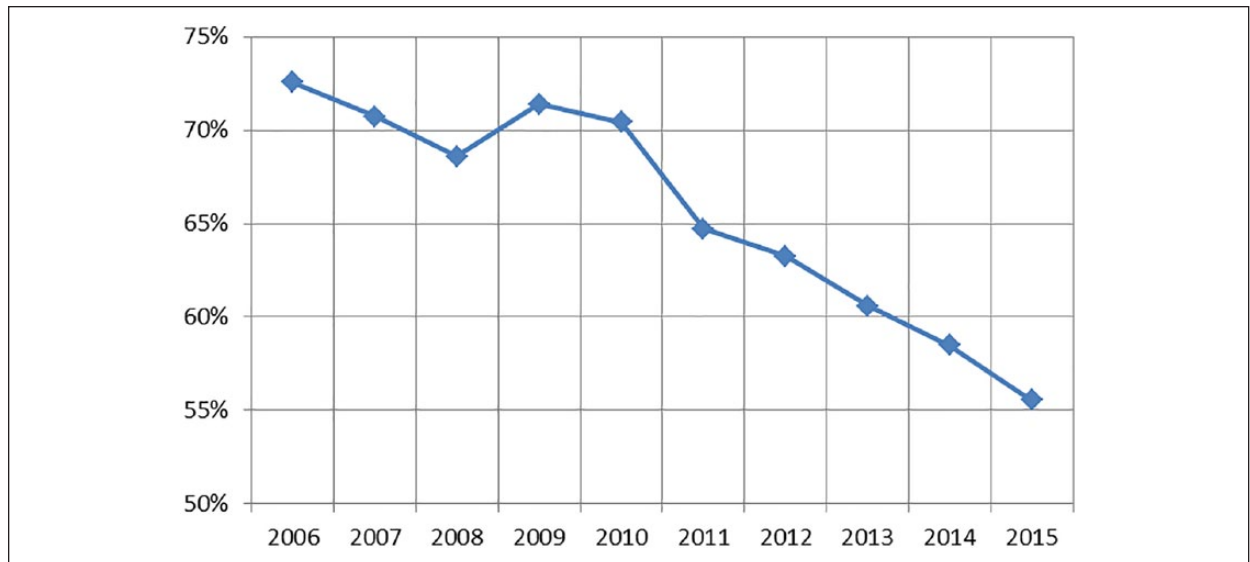


Figure 2. Shares of those who “could not afford to” among those who have unmet need for a medical examination or treatment (2006-2015).

Source. Authors’ calculations using data from SILC.

Note. SILC = Survey of Income and Living Conditions.

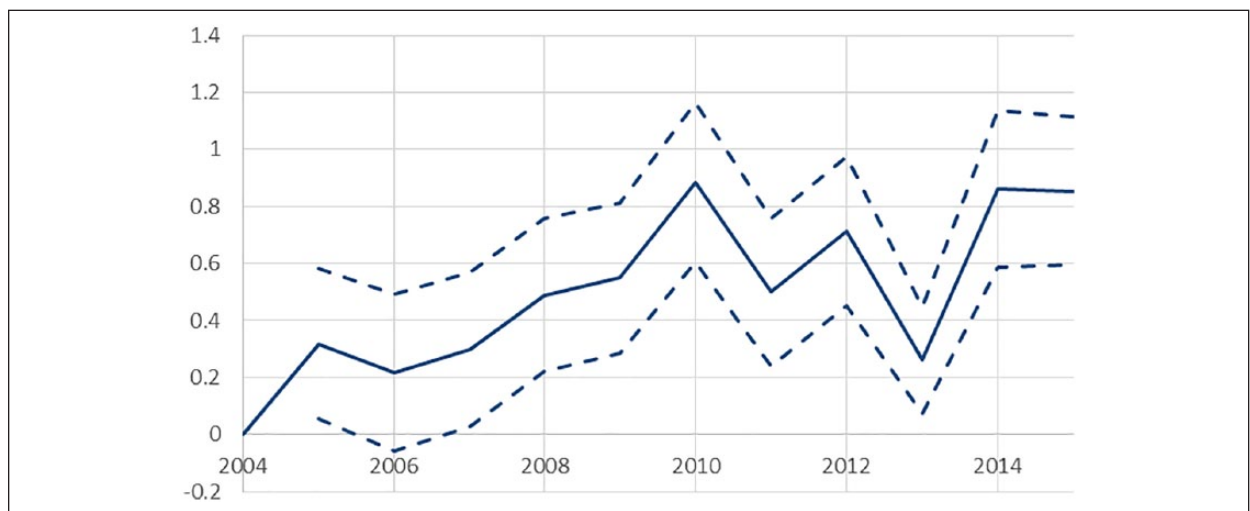


Figure 3. Increase in health service utilization over time among the elderly.

Source. Authors’ calculations using data from Life Satisfaction Survey.

Note. The graph presents coefficient estimates and 95% confidence intervals for year dummies from logistic regression. The control variables in the regression are age, sex, marital and education status, real income, and year dummies. Controlling also for self-assessed health does not affect the results qualitatively.

than half of the LSS sample consists of women (56% in 2015), and around 65% are married. More than 60% of the sample has no educational degree, whereas the share of university graduates fluctuates between 1% and 5%.

In Turkey, health service utilization of the elderly has increased over time. The LSS data show that the share of the elderly who visited a health facility increased from about 71% in 2004 to 81% by 2009 ($p < .001$) and to about 85% by 2015 ($p = .011$). Figure 3 presents coefficient estimates and 95% confidence intervals for year dummies from the logistic regression of health care utilization. The figure clearly shows that utilization

increased over time, that is, a higher share of the elderly visited a health facility relative to 2004.

Along with the increase in utilization, another important finding is how the choice of the provider changed over time. Figure 4 shows the shares of the elderly choosing different types of health providers as the point of first contact. In years 2004-2009, public secondary care (hospitals funded by MoH) remained the predominant reported choice as the source of health care, receiving about 68% of the elderly respondents. By the end of 2010, the family medicine program was available in the entire country. Figure 4 shows that from 2009 to 2011,

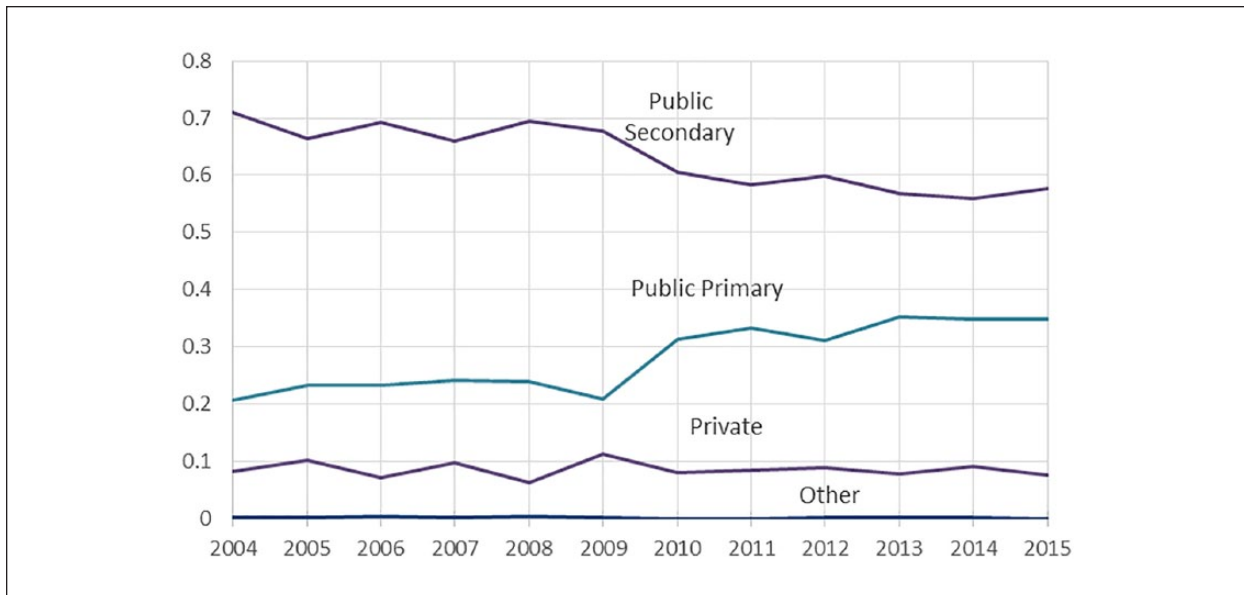


Figure 4. Health provider preference of the elderly (public primary, public secondary, private, other).

Source. Authors' calculations using data from Life Satisfaction Survey.

Note. In each year, the shares sum to 1.

preference for public secondary care declined to about 58% ($p < .001$), followed by small year-to-year changes that are not statistically significant at 5%. In the meantime, the preference for public primary care (mainly family health centers) increased from 21% in 2009 to 31% in 2010 ($p < .001$), and from 31% in 2012 to 35% in 2013 ($p = .005$). After 2013, no statistically significant change is found in the preference for public primary care. Private care as a choice of provider remained fairly stable over 2004-2015, receiving around 8% of respondents. The way the preferences for the three types of providers have changed is similar to those reported in Hone et al. (2017) for the entire adult population, except that the preference for public secondary care is a little higher among the elderly (in 2012 it was 56% among all adults vs. 60% among the elderly), and preference for private care is a little lower (in 2012 it was 13% among all adults vs. 8% among the elderly).

Figure 5 shows a breakdown of the reasons behind the provider choice, presented by provider type. Necessity declined as the reason of choice for both public primary (from 40% in 2004 to 13% in 2012, $p < .001$) and public secondary care (sharply from 81% in 2004 to 28% in 2012, $p < .001$). Proximity established itself as the reason of choice for public primary (from 52% in 2004 to 70% in 2012, $p < .001$). Proximity increased as the reason of choice even for public secondary care (from 6% in 2004 to 26% in 2012, $p < .001$). Service satisfaction increased its share as the reason of choice from 4% in 2004 to 13% in 2012 ($p = .004$) for public primary care and from 9% in 2004 to 33% in 2012 ($p < .001$) for public secondary care. For elderly patients who choose private care, service satisfaction has always been the main reason for choice at about 65.5%. These figures

are similar to the figures for the entire adult population reported in Hone et al. (2017).

Because of a change in the questionnaire in 2013, the statistics on the reason of choice are not directly comparable with those before 2013. (In the earlier years, the survey asked the reason for the patient's usual choice, whereas in the latter years the reason for the last choice.) However, the 3 years after 2012 are comparable among themselves. Between 2013 and 2015, there are no statistically significant changes in the reasons of choice of public primary care. For public secondary care, necessity decreased (from 33% in 2013 to 25% in 2015, $p < .001$), whereas service satisfaction increased (from 32% in 2013 to 38% in 2015, $p = .007$) as the reason of choice.

The overall satisfaction with health services follows a hump shape over time, as shown in Figure 6, which relies on the estimates from an ordered logistic regression. Overall satisfaction increased until 2012, after which there is a reversal in the trend. From 2013 to 2015, satisfaction was lower than it was in 2012. The year dummies plotted in the figure show how satisfaction with health services changes over time, after controlling for the effects of age, sex, marital and educational status, and household income. Full results are presented in Appendix Table A4.

Figure 7 presents the coefficient estimates and 95% confidence intervals for year dummies from eight logistic regressions (dependent variable is 1 if there is a problem and 0 otherwise). Here, the data come from survey questions that ask patients whether they had problems with some specific aspects of health services during their visit to a health facility. (Details of the questions are in Box A1 in the Appendix.) As shown in the figure,

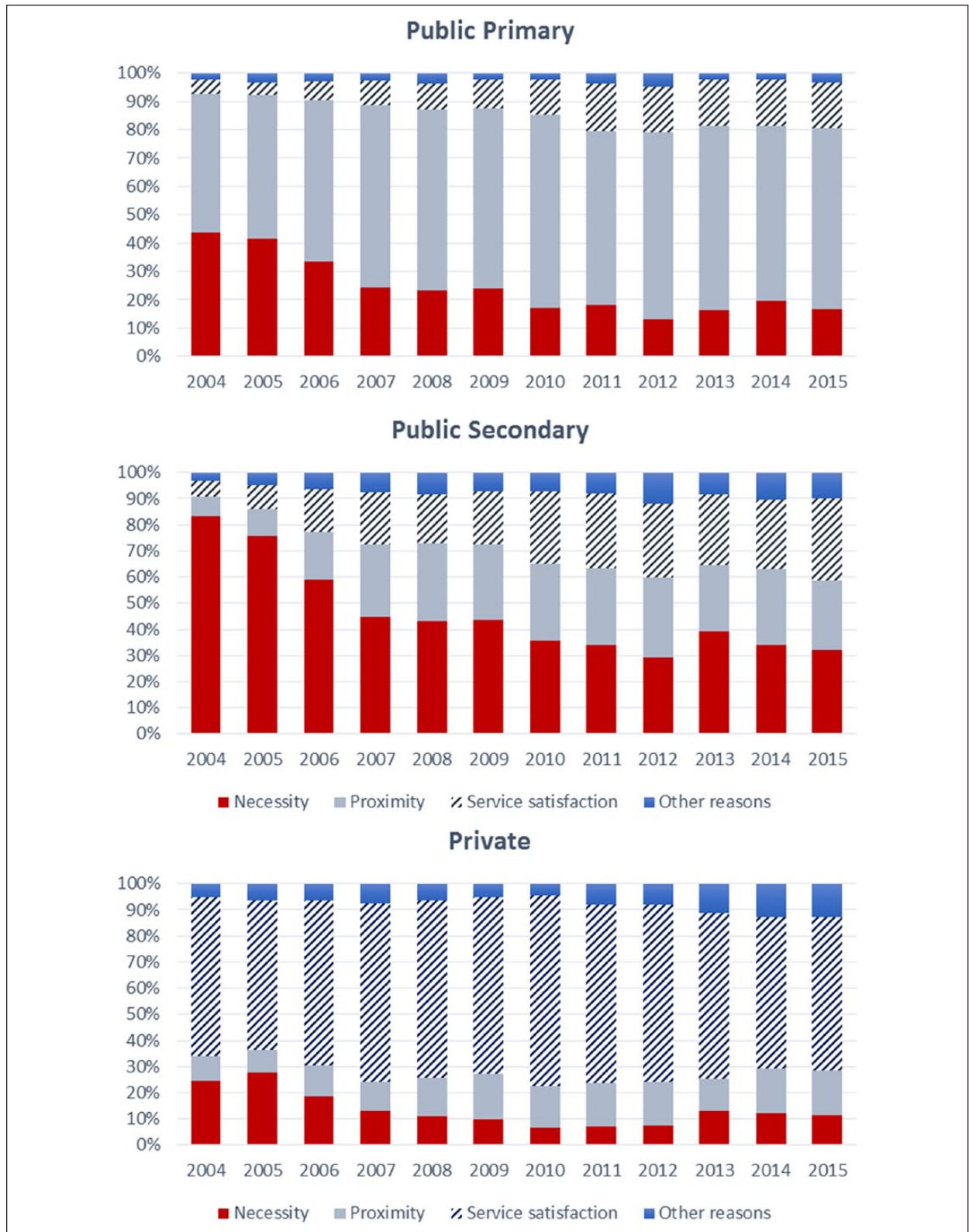


Figure 5. Reason for choosing a particular service provider grouped by provider type.
 Source. Authors' calculations using data from Life Satisfaction Survey.
 Note. In years 2013-2015, the choice of health facility is based on the patient's choice in the last visit. In earlier years, it is based on the patient's usual choice.

although a downward trend is visible in the graphs until 2011, after 2011-2012, particularly in 2014, it became

more common to report problems in the following areas: insufficiency of the number of doctors, high overall cost

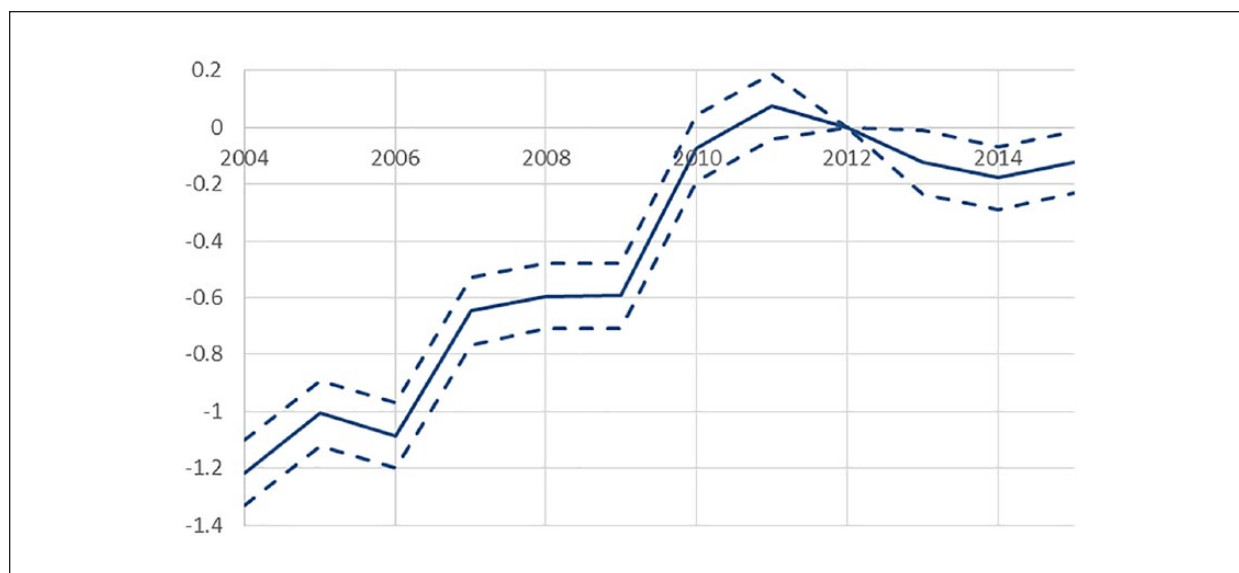


Figure 6. Satisfaction with health services among the elderly.

Source. Authors' calculations using data from Life Satisfaction Survey.

Note. The graph presents coefficient estimates and 95% confidence intervals for year dummies from ordered logistic regression. The control variables in the regression are age, sex, marital and education status, real income, and year dummies (2012 is the base year). Controlling also for self-assessed health or restricting the sample to those who used health services within the survey year does not affect the results qualitatively.

of services, high contribution fees, and dissatisfaction with the doctor's examination. We observe a decline in these problems from 2014 to 2015, but, as of 2015, problems with fees and cost were still higher than their level in 2012.

Figure 8 presents the proportion of the elderly who report a problem at a public primary or public secondary health provider. In general, a downward trend is observed up until 2013, followed by an increase in 2014. Not much difference is observed between public primary and secondary providers. As can be seen in the figure, the cost of the health services is the most frequently stated problem by the elderly. The graph of the "Problem with Cost" displays a U-shape, decreasing until 2013, but increasing afterward. As of 2015, around 45% still report a problem with cost. An increase is also observed in the problems with contribution fees after 2013. Another problematic area is the insufficiency in the number of doctors (about 40% in 2015). Problems with getting an appointment, hygiene, and behaviors have declined over time. On the contrary, having a problem with examination exhibits a relatively flat pattern.

Discussion and Conclusion

As the population is aging in Turkey, it is clear that more attention needs to be paid on planning health care needs of the elderly. The elderly have greater need, as evident in the statistics on objective and subjective measures of health. A recent study in Turkey confirmed that the prevalence of coronary heart disease rises sharply with age (i.e., >18.3% and >9.3% for elderly men and women,

respectively, compared with 10.9% and 6.9% in ages 55-64 years and <5% and <2% among 54 years or younger (Public Health Institution of Turkey, 2013). The prevalence of chronic obstructive pulmonary disease (COPD) is >13.4% and >11.9% for elderly men and women, respectively, compared with <9% and <9.3% for nonelderly men and women. The proportion of those with no (self-stated) health problems decreases with age. In a similar vein, in the Turkish LSS, 59% of the nonelderly, but 48% of the elderly are satisfied or very satisfied with their own health. Furthermore, in the SILC, only about 10.2% of the nonelderly, but a remarkable 46.2% of the elderly state own health as bad or very bad.

The elderly are heavier users of the health care system. In the LSS, 79.95% of the elderly visited a health facility during the calendar year; substantially higher than the rate for nonelderly (68.13%, p value for the difference < .001). Indeed, in all years of the LSS, the statistic is higher among the elderly than nonelderly (with p < .001). The share of the elderly in the Turkish population is anticipated to rise; therefore, the demand for services is not expected to go down.

This study shows clear evidence for an increase in utilization and the preference for primary care over secondary care in years 2004-2015 (LSS data). The rising preference for primary care is most pronounced after 2009, coinciding with the full rollout of the family medicine program. In 2006-2015, both unmet need for health care and the unaffordability of health care declined (SILC data). Therefore, there is clear evidence that the access of the elderly to health care increased over time,

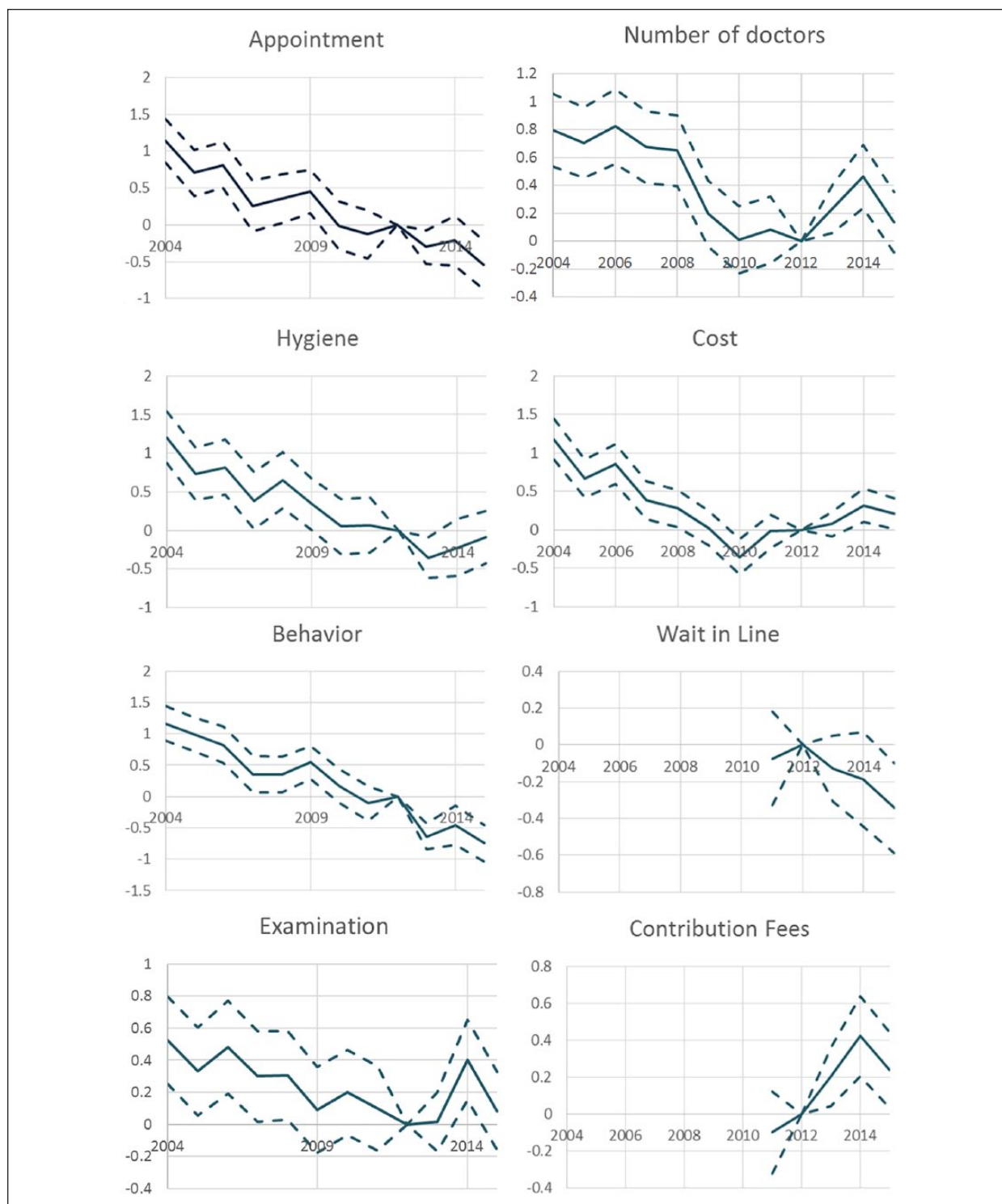


Figure 7. Problems with the health care system.

Source. Authors' calculations using data from Life Satisfaction Survey.

Note. The graph presents coefficient estimates and 95% confidence intervals for year dummies from logistic regressions (dependent variable is 1 if there is a problem, 0 otherwise). The control variables in the regression are age, sex, marital and education status, real income, and year dummies (2012 is the base year). Controlling also for self-assessed health or restricting the sample to those who used health services within the survey year does not affect the results qualitatively.

after the initiation of the HTP. Other studies confirm that utilization of health services increased significantly in Turkey (Gümüř & řahin, 2016; Hone et al., 2017). The number of visits to a physician rose from 3.1 per capita

in 2002 to 8.4 in 2015, exceeding utilization averages for OECD countries (6.9 in 2015; OECD, 2017).

It has also been found that the satisfaction of the elderly with the services increased over time, consistent



Figure 8. Proportion of the elderly reporting problems with the health care system, grouped by provider type.
 Source. Authors' calculations using data from Life Satisfaction Survey.

with the MoH publications that report the nationwide increase from 40% in 2003 to 71% in 2014. Compared to the European Union average of 62% in 2003 and 61% in 2014 (MoH of Turkey, 2016), the rise in satisfaction in Turkey is remarkable.

Other developing countries could potentially benefit from the Turkish experience by observing how

increasing access and coverage (while keeping costs under control) help achieve greater satisfaction. However, it must be understood that there are limits to rising satisfaction. Not every aspect of the current state of the health care of the elderly is bright. Challenges lie ahead. First of all, the results indicate some worrisome developments. The upward trend in satisfaction stopped after 2011-2012

and even turned downward. After 2012, the complaints of elderly patients have increased in several dimensions: costs, contribution fees, and the insufficiency of the number of doctors. Indeed, the substantial rise in utilization combined with the known shortage of physicians in Turkey, indicate a decline in the time spent per patient and raise questions about the quality of medical examinations, diagnoses, and treatments. The country needs to invest in health human capital and in the maintenance of the quality of services. As mentioned before, the elderly usually report high satisfaction with health services (i.e., higher than the nonelderly). Therefore, a decline or a stagnation in their satisfaction should be taken as a serious sign of problems in service provision and quality.

Second, health expenditures have increased over time, but they are still below the OECD average. In 2016, current health expenditures were 4.6% of GDP (compared with the OECD average of 9%; Turkish Statistical Institute, 2017). Per capita current expenditure on health was US\$ 1,088 (purchasing power parity), the lowest among the OECD countries (OECD average in 2016 was US\$ 4,003). The Turkish health care system has to face the challenge of financing the medical care of an increasing number of its elderly citizens. According to the latest statistics, the share of out-of-pocket expenditures in current expenditures is

16.3%, lower than the 20.3% average in OECD countries (OECD, 2017). Judging by the experiences of other OECD countries, it appears that the private sector may need to contribute more to defray health care costs of the elderly. The change in cost sharing will happen even though a greater share of the elderly (than before) is reporting problems about costs, contribution fees, and the insufficiency of the number of doctors.

Third, the higher utilization of health services has two reasons: first, an increase in the coverage rate and, second, an increase in the frequency of visits. Wider coverage and frequent visits are desirable, but only to the extent that the negative externality generated by frequent visitors does not disrupt service to those who do not visit a health facility but may be in greater need. A high number of visits should be traced to discover any unnecessary procedures or unsolved health problems of the elderly.

Fourth, although not directly related to the findings of this study, the country needs to make plans for a long-term care system, which was missing in the reforms initiated by the HTP.

Finally, the data set in this study covers only up to 2015. Hence, more recent data should be studied to observe whether there are any changes in the patterns discovered by this study.

Appendix

Box A1. Definitions of the Variables Used in the Analyses.

In the SILC:	
-	Unmet need: "Did you have an unmet need for medical examination or treatment during the last 12 months." "Yes" or "No."
-	"Main reason for unmet need for medical examination or treatment": "1: Could not afford to," "2: Waiting list," "3: Could not take time (because of work, care for children or others)," "4: Too far to travel / no means of transportation," "5: Fear of doctor / hospitals / examination / treatment," "6: Wanted to wait and see if problem got better on its own," "7: Didn't know any good doctor or specialist," "8: Other reasons."
In the LSS:	
-	"How satisfied are you with health services?" "5: Very satisfied," "4: Satisfied," "3: Neither satisfied, nor unsatisfied," "2: Unsatisfied," "1: Very unsatisfied."
-	Point of first contact when ill: To ensure consistency of measurement across years, the responses are grouped as "public primary," "public secondary," "private," or "other" (Hone et al., 2017).
-	The reasons for choice of provider: For clarity and consistency across years, the responses are grouped as "necessity" (meaning no other choice), "proximity" (or closeness to service provider), "service satisfaction," and "other." "Other" included the responses of "based on recommendation," "knowing someone in the service," "habit," and "low co-payment."
-	In general, do you experience problems in the following areas of service? "Problem getting an appointment," "problem with hygiene or sanitation of the facility," "problem with the physician's behavior" "problem with cost (of examination or of medication)," "problem with obtaining medication," "problem with the physician's examination," "problem with the sufficiency of number of doctors." The responses are "yes," "no," or "do not know." The majority of the responses were "yes" or "no" (about 94%-97%).
-	Utilization of health care services within the calendar year: "Yes" or "No."

Note. SILC = Survey of Income and Living Conditions; LSS = Life Satisfaction Survey.

Table A1. Number and Characteristics of the Elderly in SILC.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Individuals	3,170	3,195	3,164	3,379	3,499	4,434	5,361	6,085	6,960	7,032
% Female	0.54	0.54	0.55	0.55	0.54	0.55	0.57	0.57	0.57	0.57
% Married	0.63	0.63	0.62	0.60	0.61	0.62	0.61	0.59	0.59	0.59

(continued)

Table A1. (continued)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
% Less than primary	0.63	0.63	0.62	0.63	0.63	0.62	0.62	0.61	0.60	0.58
% Primary school	0.29	0.29	0.30	0.28	0.28	0.30	0.30	0.30	0.31	0.33
% Middle school	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
% High school	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
% University or higher	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Real income	525.32	590.78	551.60	585.01	555.86	689.89	747.32	936.42	1,180.40	1,189.42

Source. Authors' calculations using data from the Turkish SILC.

Note. The sample is restricted to ages 65 years or above. SILC = Survey of Income and Living Conditions.

Table A2. Number and Characteristics of the Elderly in LSS.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Individuals	737	811	696	699	767	897	860	975	1,044	25,797	988	1,214
% Female	0.51	0.53	0.54	0.55	0.54	0.56	0.57	0.55	0.56	0.55	0.55	0.56
% Married	0.70	0.67	0.66	0.64	0.66	0.62	0.62	0.63	0.64	0.64	0.66	0.64
% Divorced	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02
% Widow/er	0.28	0.31	0.33	0.35	0.32	0.36	0.37	0.35	0.33	0.34	0.31	0.34
% Less than primary	0.55	0.59	0.63	0.59	0.54	0.56	0.54	0.54	0.52	0.54	0.47	0.53
% Primary-middle school	0.37	0.35	0.33	0.35	0.39	0.37	0.37	0.38	0.40	0.40	0.42	0.37
% High school	0.04	0.04	0.03	0.03	0.04	0.04	0.05	0.03	0.03	0.03	0.05	0.05
% University or higher	0.03	0.03	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.03	0.05	0.05
Real income	1,290	1,347	1,320	1,195	1,374	1,474	1,457	1,623	1,640	1,280	1,706	1,576

Source. Authors' calculations using data from LSS.

Note. The sample is restricted to ages 65 years or above. % Never married (which is not shown in the table) is 1% to 2%. The sample in the 2013 survey is representative at the province level; hence, it is larger. Real income is calculated as the mid-point of the income interval in the survey, which remained the same across survey years. LSS = Life Satisfaction Survey.

Table A3. Estimates From the Logistic Regression of Unmet Need for Medical Examination or Treatment.

	Basic model		Extended model	
	Coefficients confidence intervals		Coefficients confidence intervals	
Health status				
Good			0.410*	[-0.037, 0.858]
Fair			0.918***	[0.475, 1.360]
Bad			1.520***	[1.078, 1.962]
Very bad			1.840***	[1.393, 2.286]
Age	-0.013***	[-0.017, -0.009]	-0.024***	[-0.029, -0.020]
Female	-0.195***	[-0.250, -0.140]	-0.292***	[-0.348, -0.237]
Married	-0.095***	[-0.154, -0.037]	-0.092***	[-0.151, -0.033]
Education				
Primary school	-0.601***	[-0.662, -0.540]	-0.485***	[-0.547, -0.423]
Middle school	-0.721***	[-0.895, -0.547]	-0.531***	[-0.708, -0.354]
High school	-0.946***	[-1.144, -0.748]	-0.729***	[-0.930, -0.528]
University or higher	-1.124***	[-1.359, -0.889]	-0.861***	[-1.098, -0.623]
Real income	-0.0005***	[-0.0006, -0.0004]	-0.0004***	[-0.0005, -0.0004]
Year 2007	-0.237***	[-0.356, -0.119]	-0.226***	[-0.346, -0.105]
Year 2008	-0.414***	[-0.535, -0.293]	-0.392***	[-0.516, -0.268]
Year 2009	-0.220***	[-0.336, -0.104]	-0.225***	[-0.344, -0.107]
Year 2010	-0.147**	[-0.260, -0.033]	-0.149**	[-0.264, -0.033]
Year 2011	-0.239***	[-0.348, -0.129]	-0.247***	[-0.359, -0.135]
Year 2012	-0.363***	[-0.476, -0.251]	-0.364***	[-0.478, -0.249]
Year 2013	-0.290***	[-0.396, -0.185]	-0.280***	[-0.388, -0.172]
Year 2014	-0.387***	[-0.492, -0.282]	-0.385***	[-0.492, -0.277]

(continued)

Table A3. (continued)

	Basic model		Extended model	
	Coefficients confidence intervals		Coefficients confidence intervals	
Year 2015	-0.742***	[-0.852, -0.631]	-0.753***	[-0.866, -0.640]
Constant	0.501***	[0.172, 0.831]	0.082	[-0.466, 0.630]
Observations	46,229		46,229	
Log likelihood	-20,883.814		-20,312.148	

Source. Authors' calculations using data from SILC.

Note. The sample is restricted to ages 65 years or above. The "Basic model" includes age, sex, education, income, and year dummy variables. The "Extended model" captures health status in addition to all of the variables in the basic model. The omitted categories are very good health, male, not married, less than primary school education, and year 2006. 95% confidence intervals in parentheses. SILC = Survey of Income and Living Conditions.

*p < .1. **p < .05. ***p < .01.

Table A4. Estimates From the Ordered Logistic Regression of Satisfaction From Health Services (Among Those Who Use the Services).

	Basic model		Extended model	
	Coefficients confidence intervals		Coefficients confidence intervals	
Satisfaction with own health				
Not satisfied			-0.507***	[-0.667, -0.347]
Neither satisfied nor unsatisfied			-0.735***	[-0.896, -0.573]
Satisfied			-0.885***	[-1.044, -0.725]
Very satisfied			-1.176***	[-1.365, -0.988]
Age	0.015***	[0.010, 0.019]	0.016***	[0.011, 0.020]
Female	-0.075**	[-0.138, -0.011]	-0.041	[-0.105, 0.023]
Married	0.295*	[-0.006, 0.595]	0.305**	[0.005, 0.606]
Divorced	-0.093	[-0.466, 0.279]	-0.021	[-0.395, 0.353]
Widow/er	0.142	[-0.159, 0.444]	0.161	[-0.141, 0.464]
Education				
Primary-Middle School	-0.02	[-0.083, 0.042]	-0.033	[-0.096, 0.029]
High School	-0.553***	[-0.691, -0.415]	-0.574***	[-0.712, -0.436]
University or higher	-0.659***	[-0.817, -0.501]	-0.672***	[-0.830, -0.513]
Real income	0.000*	[-0.000, 0.000]	0.000	[-0.000, 0.000]
Year 2004	-1.170***	[-1.305, -1.035]	-1.178***	[-1.314, -1.043]
Year 2005	-1.077***	[-1.210, -0.945]	-1.072***	[-1.205, -0.940]
Year 2006	-1.242***	[-1.374, -1.110]	-1.221***	[-1.353, -1.089]
Year 2007	-0.756***	[-0.892, -0.619]	-0.754***	[-0.891, -0.618]
Year 2008	-0.672***	[-0.802, -0.542]	-0.680***	[-0.810, -0.550]
Year 2009	-0.590***	[-0.720, -0.459]	-0.562***	[-0.693, -0.432]
Year 2010	-0.089	[-0.219, 0.041]	-0.091	[-0.221, 0.039]
Year 2011	-0.004	[-0.135, 0.127]	0.019	[-0.112, 0.151]
Year 2013	-0.132**	[-0.260, -0.004]	-0.105	[-0.234, 0.025]
Year 2014	-0.116*	[-0.239, 0.008]	-0.085	[-0.209, 0.040]
Year 2015	-0.096	[-0.218, 0.026]	-0.089	[-0.212, 0.034]
Observations	27,026		27,026	
Log likelihood	-24,656.3		-24,518.3	

Source. Authors' calculations using data from Life Satisfaction Survey.

Note. The sample is restricted to ages 65 years or above. The "Basic model" includes age, sex, education, income, and year dummy variables. The "Extended model" captures health status in addition to all of the variables in the basic model. The omitted categories are very unsatisfied, male, never married, less than primary school education, and year 2012. 95% confidence intervals in parentheses.

*p < .1. **p < .05. ***p < .01.

Notes

- Age is a continuous variable. Sex (the variable is "female") is equal to 1 if female and 0 otherwise. Marital status (the variable is "married") is equal to 1 if married and 0 otherwise. Education is the highest level of

educational attainment. It is "less than primary education," "primary school," "secondary school," "high school," or "university or higher"; a dummy variable is created for each. Real income is the household income deflated by the consumer price index (CPI).

2. Age is a continuous variable. Sex (name of the variable is female) is coded as 1 if the individual is female and 0 otherwise. Marital status is “never married,” “married,” “divorced,” or “widow”; a dummy variable is created for each. Education is the highest level of educational attainment. It is “less than primary education,” “primary-middle school,” “high school,” or “university or higher”; a dummy variable is created for each. Real income is the household income deflated by the CPI. Satisfaction with own health has five categories: “very unsatisfied,” “not satisfied,” “neither satisfied nor unsatisfied,” “satisfied,” and “very satisfied”; a dummy variable is created for each.

Acknowledgments

The authors are thankful to TurkStat for granting permission to use microdata from the TLSS and SILC. Comments and suggestions from Banu Ekinci, Seyhun Çakmak, and two anonymous referees are highly appreciated.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Seyit Mumin Cilasan  <https://orcid.org/0000-0003-3099-4272>

References

- Akdağ, R. (2009). *Progress report health transformation program in Turkey January 2009* (S. Aydın & H. Demirel, Eds.). Ankara, Turkey: Sağlık Bakanlığı.
- Al Yousif, N., Hussain, H. Y., & Mhakiluf, M. M. E. D. (2014). Health care services utilization and satisfaction among elderly in Dubai, UAE and some associated determinants. *Middle East Journal of Age & Ageing*, *11*(3), 25-33. doi:10.5742/MEAA.2014.92484
- Atun, R., Aydın, S., Chakraborty, S., Sümer, S., Aran, M., Gürol, I., . . . Akdağ, R. (2013). Universal health coverage in Turkey: Enhancement of equity. *The Lancet*, *382*, 65-99. doi:10.1016/S0140-6736(13)61051-X
- Baris, E., Mollahaliloglu, S., & Aydın, S. (2011). Healthcare in Turkey: From laggard to leader. *British Medical Journal*, *342*, Article c7456. doi:10.1136/bmj.c7456
- Bates, D. W., Cullen, D. J., Laird, N., Petersen, L. A., Small, S. D., Servi, D., . . . Edmondson, A. (1995). Incidence of adverse drug events and potential adverse drug events: Implications for prevention. *Journal of the American Medical Association*, *274*, 29-34. doi:10.1001/jama.1995.03530010043033
- Bloom, D. E., Canning, D., & Fink, G. (2010). Implications of population ageing for economic growth. *Oxford Review of Economic Policy*, *26*, 583-612. doi:10.1093/oxrep/grq038
- Börsch-Supan, A., Brügiavini, A., Jürges, H., Kapteyn, A., Mackenbach, J. P., Siegrist, J., & Weber, G. (Eds.). (2008). *Health, ageing and retirement in Europe: First results from the survey of health, ageing and retirement in Europe (2004-2007): Starting the longitudinal dimension*. Mannheim, Germany: Mannheim Research Institute for the Economics of Aging.
- Boutayeb, A., & Boutayeb, S. (2005). The burden of non communicable diseases in developing countries. *International Journal for Equity in Health*, *4*, Article 2. doi:10.1186/1475-9276-4-2
- Calonge, N., Petitti, D., DeWitt, T., Dietrich, A., & Gordis, L. (2009). Screening for depression in adults: U.S. preventive services task force recommendation statement. *Annals of Internal Medicine*, *151*, 784-792. doi:10.7326/0003-4819-151-11-200912010-00006
- Chawla, M., Betcherman, G., & Banerji, A. (2007). *From red to gray: The “third transition” of aging populations in Eastern Europe and the former soviet union*. Washington, DC: The World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/6741>
- Civaner, M. M., Azap, A., Pala, K., Akalın, A., Aksakoğlu, G., Aksu Tanık, F., . . . Hamzaoğlu, O. (2013). “THE LANCET” SAĞLIKTA DÖNÜŞÜM PROGRAMI’NIN “BAŞARILARI” NI DÜNYAYA PAZARLIYOR [“The Lancet” markets the “successes” of transformation in health internationally]. *Kasım-Aralık*, *28*, 403-421.
- Dang, T.-T., Oxley, H., & Antolín, P. (2001, September). *Fiscal implications of ageing* (OECD Economics Department Working Papers No. 305). doi:10.1787/503643006287
- European Commission. (2015). *The 2015 ageing report: Economic and budgetary projections for the 28 EU member states (2013-2060)* (European Economy No. 3). Brussels, Belgium.
- Faruqee, H. (2002, February). *Population aging and its macroeconomic implications: A framework for analysis* (IMF Working Paper WP02/16, 0216). Washington, DC.
- Fiore, A. E., Shay, D. K., Broader, K., Iskander, J. K., Uyeki, T., Mootrey, G., . . . Cox, N. J. (2009). Prevention and control of seasonal influenza with vaccines: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recommendations and Reports*, *58*(RR-8), 1-52.
- Gümüş, R., & Şahin, A. (2016). Utilization of health services by the elderly in Turkey between 2008 and 2012: Analysis of Turkstat Health Surveys. *Düzce Üniversitesi Sağlık Bilimleri Enstitüsü Dergisi*, *6*, 74-78.
- Hone, T., Gurol-Urganci, I., Millett, C., Başara, B., Akdağ, R., & Atun, R. (2017). Effect of primary health care reforms in Turkey on health service utilization and user satisfaction. *Health Policy and Planning*, *32*, 57-67. doi:10.1093/heapol/czw098
- Jang, Y., Chiriboga, D. A., & Kim, G. (2005). Health, health-care utilization, and satisfaction with service: Barriers and facilitators for older Korean Americans. *Journal of the American Geriatrics Society*, *53*, 1613-1617. doi:10.1111/j.1532-5415.2005.53518.x
- Johansen, A., & Guisset, A. L. (2012). *Successful health systems reforms: The case of Turkey*. Copenhagen, Denmark: World Health Organization Europe.
- Knickman, J. R., & Snell, E. K. (2002). The 2030 problem: Caring for aging baby boomers. *Health Services Research*, *37*, 849-884. doi:10.1034/j.1600-0560.2002.56.x
- Lee, R., Mason, A., & Cotlear, D. (2010). *Some economic consequences of global aging* (Health, nutrition and population discussion paper). Washington, DC: The World Bank.

- Lopreite, M., & Mauro, M. (2017). The effects of population ageing on health care expenditure: A Bayesian VAR analysis using data from Italy. *Health Policy, 121*, 663-674. doi:10.1016/j.healthpol.2017.03.015
- Mahfouz, A. A., Al-Sharif, A. I., El-Gama, M. N., & Kisha, A. H. (2004). Primary health care services utilization and satisfaction among the elderly in Asir region, Saudi Arabia. *Eastern Mediterranean Health Journal, 10*, 365-371.
- Ministry of Health. (2015). *Turkey healthy aging action plan and implementation program 2015-2020*. Ankara, Turkey: Turkish Public Health Institution, Republic of Turkey Ministry of Health.
- Ministry of Health, Public Health Institution. (2012). *Strategic plan of public health institution 2014-2017*. Ankara, Turkey: Department of Strategy Development, Strategic Planning and Management, Public Health Institution, Republic of Turkey Ministry of Health.
- Ministry of Health of Turkey. (2016). *Health statistics year-book 2015*. Ankara: General Directorate of Health Research, Ministry of Health of Turkey.
- Ökem, Z. G., & Çakar, M. (2015). What have health care reforms achieved in Turkey? An appraisal of the "Health transformation programme." *Health Policy, 119*, 1153-1163. doi:10.1016/j.healthpol.2015.06.003
- Organisation for Economic Co-operation and Development. (2017). *OECD health statistics 2017—Frequently requested data*. Retrieved from <http://www.oecd.org/els/health-systems/health-data.htm>
- Public Health Institution of Turkey. (2013). *Chronic diseases and risk factors survey in Turkey* (Ministry of Health Publication No. 909). Ankara, Turkey.
- Savas, B. S., Karahan, O., & Saka, R. O. (2002). Health care systems in transition: Turkey. In S. Thomson & E. Mossialos (Eds.), *European observatory on health care systems* (Vol. 4(4)). Copenhagen, Denmark. Retrieved from <http://www.who.int/iris/handle/10665/107491>
- Shrivastava, S. R. B. L., Shrivastava, P. S., & Ramasamy, J. (2013). Health-care of elderly: Determinants, needs and services. *International Journal of Preventive Medicine, 4*, 1224-1225.
- Tatar, M., Mollahaliloğlu, S., Şahin, B., Aydın, S., Maresso, A., & Hernández-Quevedo, C. (2011). Turkey: Health system review. *Health Systems in Transition, 13*(6), 1-186.
- Turkish Statistical Institute. (2015). *Istatistiklerle Yaşlılar, 2014* [Statistics on the Elderly, 2014] (News bulletin No. 18620). Author. Retrieved from <http://www.tuik.gov.tr/PreHaberBultenleri.do?id=18620>
- Turkish Statistical Institute. (2014). *Income and living conditions survey micro data set (cross-sectional) 2014*. Ankara, Turkey.
- Turkish Statistical Institute. (2015). *Life satisfaction survey micro data set 2015*. Ankara, Turkey.
- Turkish Statistical Institute. (2017). *Health expenditure statistics, 2016*. Retrieved from <http://www.turkstat.gov.tr/PreHaberBultenleri.do?id=24574>
- WHO Regional Office for Europe. (2018). *European health for all database*. European Health Information Gateway. Retrieved from <https://gateway.euro.who.int/en/datasets/european-health-for-all-database/>
- The World Bank. (2003). *Turkey—Reforming the health sector for improved access and efficiency*. Washington, DC: Author. Retrieved from <http://documents.worldbank.org/curated/en/919651468760505354/Turkey-Reforming-the-health-sector-for-improved-access-and-efficiency>
- The World Bank. (2013). *Turkey—Performance based contracting scheme in family medicine: Design and achievements*. Washington, DC. Retrieved from <http://documents.worldbank.org/curated/en/880861468338993763/Turkey-Performance-based-contracting-scheme-in-family-medicine-design-and-achievements>
- The World Bank. (2017). *World development indicators, life expectancy at birth*. Author. Retrieved from <http://databank.worldbank.org/data/reports.aspx?source=2&series=SP.DYN.LE00.IN&country=>
- World Health Organization. (2013). *World health statistics*. Geneva, Switzerland: Author.
- World Health Organization. (2018). *Ageing and health: Key facts*. Retrieved from <http://www.who.int/en/news-room/fact-sheets/detail/ageing-and-health>
- Xesfingi, S., & Vozikis, A. (2016). Patient satisfaction with the healthcare system: Assessing the impact of socio-economic and healthcare provision factors. *BMC Health Services Research, 16*(1), Article 94. doi:10.1186/s12913-016-1327-4
- Yasar, G. Y. (2011). "Health transformation programme" in Turkey: An assessment. *The International Journal of Health Planning and Management, 26*, 110-133. doi:10.1002/hpm.1065