The Effects Of Health Expenditure To Decrease Infant Mortality Rate In OECD Countries

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ABSTRACT

There is a positive relationship between the health level of the society and its economic development. The main reason is that improving quality of the lives and increasing lifetime lead to higher economic performance. In this context, infant mortality rate is accepted as an indicator to measure the impact of health expenditure on the life quality. Therefore, this study aims to evaluate the relationship between health expenditure and infant mortality rate in OECD countries. For this purpose, firstly, a detailed literature review is performed and the trend of health expenditure in these countries is explained. After that, the effects of infant mortality rate on economic development of the countries are underlined. In the analysis process, 20 different countries in OECD are selected and annual data of these countries for the years between 1980 and 2017 is evaluated with the help of Kao panel cointegration and Dumitrescu-Hurlin causality analysis. The findings show that there is long term relationship between health expenditure and infant mortality rates in OECD countries. Another important conclusion is that there is a causality analysis from health expenditure to the infant mortality rate. While considering these results, it is recommended that OECD countries should take some actions in order to increase health expenditure so that it can be possible to decrease infant mortality rate.

Keywords: Health Expenditures; Infant Mortality; Health Economics

INTRODUCTION

Health expenditures are an important indicator of the development of developed and developing countries. There is a positive relationship between health expenditures and the level of development of economies. The increase in the health expenditures increases the life expectancy of a country's population and thus the life expectancy and economic growth are positively affected in the long term. Increasing the economic growth and welfare of countries in the long term is measured by the importance they attach to health expenditures.

In many countries of the world, new applications and system changes are being made to improve the health sector. Today, health indicators of countries are now accepted as the main factors determining the level of development. Therefore, health services need to be developed and expanded both nationally and internationally. The increase in health expenditures in recent years, as in many countries, leads to also a discussion of health policies in OECD countries. OECD countries are making rapid progress not only in terms of health expenditures but also in terms of prolongation of and quality of life with a reduction in infant mortality rates. Therefore, testing the effect of health expenditures on infant mortality is an issue to be investigated.

In our study, the effect of health expenditures on infant mortality rates in OECD countries was tested with panel cointegration and panel causality analyzes. 20 OECD countries with data between 1980 and 2017 were selected and analyzed. In the first part of our study, the development of health expenditures in the world was mentioned, in the second part, the literature study related to the subject is given and in the third part, the findings of the study are discussed. In the last part, the study was also completed with results and evaluation.

DEVELOPMENT OF HEALTH EXPENDITURES IN THE WORLD

The amount a country spends on health can be influenced by a wide array of social and economic determinants. In addition, the financing of the health system, organizational structure and organizational structure can also affect. There is a close relationship between the income level of a country and the amount of expenditure of its population on health care (OECD/EU, 2018).

Health expenditures have been in an increasing trend all over the world in recent years. Health expenditures in developed countries are affected by the adoption of new medical technologies to treat chronic diseases. In developing countries are directed to cost-effective technologies to treat infectious diseases (Çelik et al., 2016).

Health expenditures are one of the important issues of discussion all over the world. In the historical process, health expenditures are generally seen to be in an upward trend. In the 1970s, the share of OECD countries in GNP for health was around 6% on average. This share has increased over the years (Martin et al., 2011).

Prior to 2009, average health expenditures were realized by 4-6% annually as a result of rising prices in the health sector. Moreover, health expenditures are closely following economic growth since 2012. For example, health expenditures per capita in Greece in 2017 (at 2010 prices) remained below the 2009 level of approximately 30%. In Portugal, Italy and Spain, per capita expenditure have reached pre-crisis levels. Health expenditures in Latvia and Estonia also declined significantly in the early periods of the crisis, but health expenditures continued to rise rapidly after this period. For these two countries, health expenditure in 2017 is about 40% of the 2009 level. Excluding Europe as well the rate of increase in health expenditures slowed down during the economic crisis. Health expenditures in Korea have increased by 6% on average since 2009. This shows that expenditure per capita in 2017 is 55% higher than in 2009. Australia, Canada and the United States have also increased steadily in this period, and expenditure per capita levels were 10-20% higher than in 2009. Health expenditures constituted 8.9% of gross domestic product (GDP) in 2016 (0ECD, 2018)

Health expenditures in the United States (17.2% of GDP) represent a much larger part of the economy, followed by Switzerland (12.3%) and France (11.5%) as the second and third highest expenditure countries. Countries such as Turkey (4.2%) and Mexico (5.4%) have accounted for less than 6% of GDP. Each one of those country's (Mexico, Turkey and Colombia) health expenditure is around one-tenth of the United States (approximately USD 1,000 per person) (0ECD, 2018).

Negative health expenditure growth across Europe following the economic crisis in 2008, growth rates picked up again in almost all countries in recent years. Across the European Union, health expenditure per capita increased by around 1.9% each year in real terms between 2013 and 2017, compared with an annual growth rate of only 0.6% between 2009 and 2013. During the subsequent four-year period, there has been a large-scale turnaround with all but two EU countries seeing some growth in health expenditure, albeit growth has remained slow in some countries (OECD/EU, 2018).

In the models established for the future of health expenditures, the increase in health expenditures is expected to continue in the following years. Various policies are being developed to increase the value of health expenditure in the world and various improvements are being made at the health level of the community (Hadad et al., 2013).

According to the Human Development Index (2017), the life expectancy at birth in countries such as Canada, Australia, USA, Switzerland, Denmark, Belgium, Japan, Italy, which allocates a significant portion of GDP to health expenditures is over 80 years; in countries such as Pakistan, Syria, Philippines, Turkmenistan and Indonesia, the economic development level is lower than 70 years. In countries like Turkey, Thailand, Tunisia and Bulgaria, the expected life expectancy was 75 years on average (TUIK, 2018).

Health expenditures are made primarily with pooled funds raised through taxes and employee benefit plans. Decisions about how much to spend on each person from that pool will be based on individual medical needs. Insurance and government financing are ways to make sure that a person's ability to pay or family income does not limit the care they receive when they need it. Yet collectively the ability of everyone to pay, their aggregate prior contributions in taxes and insurance premiums, puts an absolute limit on how much can be spent in total on all the individulals treated. As the focus shifts from micro to macro allocation, the signicant determinant of expenditure shifts from medical need to avaliable income (Table 1) (Getzen, 2013).

Table 1: Micro and Macro Determinants of Health Expenditure

Micro ⇄ **Macro**	
Health Status	**GDP per capita**
Individual differences in medical expenditure are determined mostly by differences in health status, i.e., whether or not the person is sick	National differences in expenditure per person are largely determined by differences in income.

Source: Getzen, T.E. (2013). Health Economics and Financing, Temple University and İHEA, Wiley, Fifth Edition, 376.

There is a close correlation between the economic development of a society and its health level. The budget allocated for health in countries whose economic development has reached a certain level shows an increase. However, the level of knowledge and awareness of individuals regarding health will also increase. Otherwise, the improvement in health conditions supports the economic development of the country. Therefore, studies show that economic indicators and health indicators positively affect each other. The source allocated to health services in the world is in parallel with the increase in the level of development (Ersoz, 2008). Moreover, the life expectancy and expectations of individuals are increasing with the effect of the increase in health expenditures (Kelly, 1997).

Health care and health care expenditures are focused on the future like other sectors. Focusing on the future is a fact that is at the core of the concept of investment. Therefore, health expenditures are not much different from resources allocated to major infrastructure projects. The potential return on investments to health is not seen as fast other sectors. Investments in basic health services are subject to prejudice in society. Countries should consider long-term analysis in the planning of investments. Thus, investments in health care can be handled more carefully in economic development plans (Suhrcke et al., 2005, 85).

LITERATURE REVIEW

A summary of the current studies in the literature on our subject is included in Table 2.

Table 2: Literature Review

Author	Method	Period	Result
Liang, Tussing, (2019)	Economic Time Series	1995-2014	The present research investigates the extent to which population health outcomes are affected by responses of government health expenditure (GHE) to business cycles, i.e., cyclicality of GHE. They estimate GHE cyclicality by regressing detrended GHE on detrended gross domestic product (GDP).
Alptekin, Yeşilaydın, (2016)	Fuzzy Data Envelopment Analysis	2012	This study aims to determine health efficiencies of OECD countries. 34 member countries of the OECD were taken into consideration and the number of the most suitable cluster was five; three countries in the first cluster, nine in the second cluster, nine in the third cluster, six in the fourth cluster, and seven in the fifth cluster. Turkey is located in the fourth cluster.
Bayın, (2016)	Regression Analysis	2013	As a result of the research, it was concluded that the most influential variable in the life expectancy expected in both men and women was the infant mortality rate. Health expenditures per person and health service usage levels are among the variables that have the most impact on the life expectancy expected at the age of 65.
Teker et al., (2012)	Unit Root Test, Cointegration Test, Vector Error Correction Model	1975-2009	Demographic and economic factors, such as the rate of national income of health expenditures, the rate of workable population of the elderly population, the number of beds per thousand persons per thousand, the number of doctors per thousand patients and the ability of men and women to affect their lives were analyzed. It has been found that each factor studied has a significant effect on the life expectancy of men and women.

Fayissa, Gutema, (2005)	Panel Data Analyses	1990-2000	The results of the study, which has a health production function in Africa with socioeconomic factors showed that per capita income, literacy and food availability variables play a positive and significant role in life expectancy.
Lubitz, Cai, Kramarow, Lentzner, (2003)	Using Medicare Current Beneficiary Survey	1992-1998	By developing a model to illustrate the relationship between health, longevity and health expenditures, they realized life expectancy estimates. Their study show that for the elderly better health results in longer life but not in higher health care expenditures.
Kabir, (2008)	Multiple Regression, Probit Models	UNDP (2004, 1994), UNCTAD (2004), World Bank (2003)	In the model which was created using many variables such as per capita income, education, health expenditures and urbanization, it was concluded that none of these variables were effective in determining the expected living time.
Obrizan, Wehby, (2008)	Using Guantile Regression Model	2006-2011	The results suggest that increasing health expenditure in countries withlow life expectancy may have important returns to life expectancy and significantly diminish globalinequalities in longevity and development by reducing the spread of the world's life expectancy distribution.
Tüylüoğlu, Tekin, (2009)	Multiple Regression Method	2003	The conclusions from analyses suggest that life expectancy at birth and infant mortality rates are affected more by health expenditures than income levels denoting that increasing income level is not only a reliable factor. This result is consistent with the arguments of development economics.
Şamkar, Güner, (2018)	The Least Squared Method, Biased Estimation Techniques Ridge and Liu Estimators	2013	It was found that among the parameter estimations calculated using both Ridge and Liu estimators, the variables of number of births, health expenditures and total population were statistically significant variables for explaining the number of deaths of children under five years old and that the biggest contribution for explaining variation in the dependent variable belonged to the variable of number of births a negative relationship was found between the health expenditures and the number of deaths in children under five years of age.

Kızılkaya, Dağ, Kızılkaya, (2017)	Cointegration Test, FMOLS Method.	1975-2014	There was a positive and statistically significant correlation between life expectancy and health expenditures at birth, and a negative and statistically significant correlation between infant mortality and health expenditures. There was a negative and statistically significant correlation between mortality rate and health expenditures under the age of 5 years.
Yalçın, Çakmak, (2016)	Durbin-Watson Testi, White Testi, Regression Analysis	1991-2013	It has been concluded that public health expenditure during the period had a significant impact on human progress and impatient treatment organizations and health staff are more needed because both total health expenditure and public health expenditure are under the OECD average.
Kovacı, Belke, Bolat, (2018)	Panel Data Model	2008-2015	The results of the panel data analysis show that health care expenditures are necessity goods in developed countries, and luxury goods in developing and underdeveloped countries. Life expectancy, population, prices, and global crisis are effective factors on health care expenditures except for per capita income in developed countries and developing countries, while prices are only efficient factor in underdeveloped countries.
Howdona, Rice, (2018)	Panel Data Model	2005-2006 2011-2012	Their study show that health care expenditures is determined by proximity to death rather than age and that proximity to death is itself a proxy for morbidity.
Linden, Ray, (2017)	Panel VAR Models and Impulse Response Analys	1970-2012	The results stress the importance of the positive relationship between public health expenditures and life expectancy. Additional results based on private health expenditure as a share of GDP show also the importance of private expenditures for life expectancy, although these are at the same time also drive nup by public health expenditures.
Heuvel, Olaroiu, (2017)	Bivariate Correlation, Linear Regression Analysis	-	The regression analysis shows that in countries that spend a high percentage of their GDP on social protection, that have fewer curative beds and low infant mortality, whose citizens report fewer unmet health care needs and drink less alcohol, citizens have a significant longer life expectancy.

Shang, Goldman, (2008)	Hazard Models, Regression Analyses	1992-1999	They show that using life expectancy rather than age results in lower projections of future health care expenditures. This result suggests that increases in longevity might be less costly than models based on the current age profile of expenditure would predict.
Ersöz, (2009)	The Hierarchical Method and Two Non-hierarchical Methods, the K-Means and Medoid Clustering Method.	2004	The most significant variables among health indicators in 2004 (such as health expenditures per capita, life expectation at birth and death number per 1000 births) were used in the analysis. In conclusion Turkey clusters with Poland, Slovak Republic, Czech Republic, Hungary, Mexico, Korean Republic, according to non-hierarchical (K-means) clustering, with Portugal, Poland, Slovak Republic, Hungary, Czech Republic, Mexico, and Korean Republic and according to Medoid clustering, only with Mexico.
Öngel, Altındağ, Öngel, (2014)	T Test, One Way Anova	2007-2012	For BRIC ve MINT countries, the relationship between health expenditure percapita and life expectancy at birth time and mortality rates of children under age 1 are analyzed retrospectively. It has been observed that the longest life expectancy was 77 years in Mexico and that Turkey and China were behind this country. Turkey ranks third in per capita health expenditures after Brazil and Russia, and has the lowest rates of child deaths under 1 year old with China after Russia.
Khosroshahi, (2018)	New Generation Dynamic Panel Data Analysis, Durbin-Hausman Method, panel ARDL Method	1990-2015	The determinants of infant mortality rates are per capita health expenditure, per capita national income and inflation. The most important determinants of the coarse birth rate and life expectancy at birth are; per capita health expenditure, per capita national income and unemployment rate.
Arslanhan, (2010)	Comparison and Evaluation	1980-2008	Health expenditures and basic health indicators have been examined in relation to EU-15 and other countries and Turkey's expenditures and indicators have been observed to be closer to the EU-15 average. While health expenditures increased and life expectancy increased rapidly during the 1980-2008 period, the infant mortality rate decreased significantly.

Lee, Miller, (2002)	Stochastic Time Series Models	2002	Stochastic time series models are estimated for historical variations in fertility, mortality, and health expenditure per capita in the United States, and used to generate stochastic simulations of the growth of Medicare expenditures. They find a 95 percent probability that Medicare expenditure in 2075 will fall between 4 percent and 18 percent of GDP, indicating a wide band of uncertainty.
Burner, Waldo, McKusick, (1992)	Trend Analysis	1990-2030	It is estimated that US national health expenditures will increase by 8.3% annually from 1990 to 2030. However, it suggests that population aging increases annual health expenditures by 0.06% and the effect is low.
Getzen, (1992)	Cross Section, Time Series	1960-1988	There is a positive and meaningful relationship between population ageing and health expenditures.
Karasoy, Demirtaş, (2018)	Panel Data Analysis	2000-2015	The determinants of health expenditures were examined by taking into consideration the data of 2000-2015 period for selected 27 OECD countries. In all four models, which correspond to each pollutant employed; income, life expectancy, improvements in governance and dependency ratio significantly and positively affect health expenditures.
Riumallo-Herl, Canning, Salomon, (2018)	Sullivan's method.	2010-2015	They propose poverty-free life expectancy (PFLE) as a new metric that uses widely available data to provide a composite measure of population health and economic wellbein. In 67 of 90 countries, the difference between life expectancy and PFLE was greater for females than for males, indicating that women generally live more years of life in poverty than men do.
Halicioglu, (2011)	Time Series Data, Cointegration Framework	1965-2005	Empirical results suggest that nutrition and food availability along with health expenditures are the main positive factors for improving longevity whereas smoking seems to be the main cause for mortality.

Wang, (2002)	Instrumental Variable (IV)	1990-1999	DHS data from over 60 low-income countries between 1990 and 1999 reveal two interesting observations. First is the observed negative association between the level and inequality in child mortality. Second is the significant gap in child mortality between urban and rural areas, with rural population having a much slower reduction in mortality compared with their urban counterpart. They find that, at the national level, access to electricity, vaccination in the first year of life and public health expenditure can significantly reduce child mortality.
Nixon, Ulmann, (2006)	Panel Data Analysis	1980-1995	The findings show that increases in health care expenditure are significantly as sociated with large improvements in infant mortality but only marginally in relation to life expectancy. They make only a marginal contribution to the improvement of male and female life expectancy.
Behr, Theune, (2017)	Data Envelopment Analysis (DEA)	2012	The results of analysis hinted strongly that absolute income and health expenditure per capita have no proportional effect on life expectancy. They sighted very moderate effects of relative health care expenditure and equality on life expectancy in their study.
Rahman, Khanam, Rahman, (2018)	Panel Data Analysis	1995–2014	Total health expenditure, public health expenditure and private health expenditure significantly reduced infant mortality rates and the extent of effect of private health expenditure was greater than that of public health expenditure. Private health expenditure also had a significant role in reducing the crude death rate. Per capita income growth and improved sanitation facilities also had significant positive roles in improving population health in the region.
Bein, Unlucan, Olowu, Kalifa, (2017)	Panel Regression	2000-2014	First, they documented that there is a strong, positive relationship between total healthcare expenditures and total life expectancy. They found that healthcare had a stronger effect on improving life expectancy in females than in males. Moreover, they found a negative relationship between healthcare expenditures and the number of neonatal, infant, and under-five deaths.

Lichtenberg, (2000)	Time Series Analysis	1960-1997	It estimates longevity models using annual U.S. time-series data on life expectancy, health expenditure and medical innovation. The empirical analysis provides strong support for the hypothesis that both medical innovation and expenditure on medical care contributed to longevity increase during the period 1960-1997.
Barlow, Vissandjée, (1999)	Multivariate Cross-National Analysis of National Life Expectancy at Birth, Purchasing Power Parity Method	1990	Health expenditure fails to have much impact on national life expectancy. But it is unclear whether this result is due to real impotence or to multicolinearity. It is found that literacy, per capita income, and access to safe water supplies have significantly positive effects on life expectancy.
Kim, Lane, (2013)	Linear Mixed Model, Mixed-Effect Model	1973-2000	The findings showed a negative relationship between government health expenditure and infant mortality rate and a positive relationship between government health expenditure and life expectancy at birth. The results suggest that higher government expenditure on medical goods and services can be shown to provide better overall health results for individuals.
Gallet, Doucouliagos, (2017)	Meta-Regression Analysis (MRA)	1969-2014	Healthcare expenditure is found to have the greatest impact on the mortality rate compared to life expectancy. MRA results reveal that the expenditure elasticity for the mortality rate is particularly sensitive to data aggregation, the specification of the health production function, and the nature of healthcare expenditure.
Sayılı, Sayman, Vehid, Köksal, Erginöz (2017)	Shapiro-Wilk Test Single Sample T test	2013, 2015	In their study, Turkey is statistically significantly lower according to the OECD countries average in the life expectancy in women and men, healthy life expectancy; and statistically significantly higher in neonatal mortality rate, under-five mortality rate and maternal mortality rate.
Reynolds, Avendano, (2018)	Fixed Effects Models	1980-2010 2016	The U.S. life expectancy lag could be considerably smaller if U.S. expenditures on education and incapacity programs were comparable with those in other high-income countries.

Jakovljevic, Vukovic, Fontanesi, (2015)	Data Envelopment Analysis	1989-2012	The strongest expenditure growth was recorded in EU 2004 followed by SEE and the CIS. A surprisingly similar longevity increase was present in SEE and EU 2004. In 1989, countries that joined EU in 2004 were relatively inefficient in the number of life-years gained yet had a lower life expectancy than the SEE region and was only slightly higher than the CIS region (DEA). By 2012 the revenue spent was roughly linear to additional life-year expectancies.
Jabaa, Balana, Robu, (2014)	Panel Data Analysis	1995-2010	In this investigation, the aim was to assess the relationship between life expectancy at birth and health expenditure per capita by groups of countries with different development levels and geographic positions. The results of the panel data analysis using the fixed effects model revealed that inequalities in health care expenditures explain the different outcomes of health care systems, by groups of countries defined according to income level and geographic region.

In the literature, there are studies on the relationship between health expenditures and income. Liang and Tussing (2019) in their research investigates the extent to which population health outcomes are affected by responses of GHE to business cycles, i.e., cyclicality of GHE. They estimate GHE cyclicality by regressing detrended GHE on detrended gross domestic product (GDP). Jabaa et al. (2014) have investigated the influence of health resources on health outcomes for groups of countries defined according to the income level and geographic position. Their study revealed that inequalities in health care expenditures explain the different outcomes of health care systems. The results of this research show that the variation of health expenditures per capita is also more important among the developed and developing or less developed countries, and this difference is growing in time. Heuvel and Olaroiu (2017) in their study show that in countries that spend a high percentage of their GDP on social protection, that have fewer curative beds and low infant mortality, whose citizens report fewer unmet health care needs and drink less alcohol, citizens have a significant longer life expectancy. According to Kovacı et al. (2018) life expectancy, population, prices, and global crisis are effective factors on health care expenditures except for per capita income in developed countries and developing countries, while prices are only efficient factor in underdeveloped countries. Lee and Miller (2002) in their study develop stochastic forecasts of Medicare expenditures over the next 75 years. They find a 95 percent probability that Medicare expenditure in 2075 will fall between 4 percent and 18 percent of GDP, indicating a wide band of uncertainty. Karasoy and Demirtaş (2018) stated that income, life expectancy, improvements in governance and dependency ratio significantly and positively affect health expenditures. Ersöz (2009) stated that the first 20 countries participating in OECD are developed countries and are high income countries that transmit enough resources for health expenditures. According to this, Turkey is within the 10 countries and middle-income groups that joined the OECD later and is similar to the health indicators of these countries. Reynolds and Avendano (2018) stated that the U.S. life expectancy lag could be fairly smaller if U.S. expenditures on education and incapacity programs were comparable with those in other high-income countries.

There are a variety of studies examining the relationship between health expenditures and life expectancy for the main theme of the study. For example Lubitz et al. (2003) in their study show that for the elderly better health results in longer life but not in higher health care expenditures. Obrizan and Wehby (2008) in their study suggest that increasing health expenditure in countries withlow life expectancy may have important returns to life expectancy and significantly diminish global inequalities in longevity and development by reducing the spread of the world's life expectancy distribution. Şamkar and Güner (2018) in their study it was stated that the variables of number of births, health expenditures and total population were significant variables for explaining the number of deaths of children under five years old. Moreover the most important contribution for explaining variation in the dependent variable was belonged to the variable of number of births. Linden and Ray (2017) stated that private and public health expenditures had a similar positive impact on life expectancy on the highest public share cluster in their study. They stressed that the private expenditures is important for life expectancy. Shang and Goldman (2008) in their study stated that age has very little additional predictive power over health expenditures after life expectancy was checked. On the other hand, when health status measures are included in the model, predictive power of life expectancy is reduced. Öngel et al. (2014) analyzed retrospectively the relationship between health expenditure per capita and life expectancy at birth time and mortality rates of children under age 1 for BRIC and MINT countries. It was stated the longest expected life expectancy was in Mexico (77 years), Turkey and China were behind Mexico. Yalçın and Çakmak (2016) stated that public health expenditure during the period between 1991-2013 years had a significant impact on human progress in their study and impatient treatment organizations and health staff are more needed. Burner et al. (1992) stated that by the year 2030, as the babies of America entered the seventies and eighties, health expenditures will be 32 per cent of GDP. Getzen (1992) in his study stated that aging is not a important cause of rising health care costs, can help to lessen the frequent and misleading blaming of elderly persons. Behr and Theune (2017) in their study sighted very moderate effects of relative health care expenditure and equality on life expectancy. Jakovljevic et al. (2015) stated that EU 2004 members were the best performers in terms of balanced longevity increase following the rise in health expenditure. Bein et al. (2017) in their study stated that there was positive relationship between total healthcare expenditures and total life expectancy. They also indicated a negative association between healthcare expenditures and the number of neonatal, infant, and under-five deaths. Lichtenberg (2000) in his study estimated the longevity model on life expectancy, health expenditure and medical innovation for the period 1960-1997. Analysis results showed that medical innovation and medical care expenditures contributed to increase length of life in the period of 1960-1997. Barlow and Visandjée (1999) carried out a multivariate cross national analysis of life expectancy at birth in 1990. Literacy, income per capita and access to safe water resources have had a positive impact on life expectancy, while health expenditure per capita and urbanization have had a poor impact. Kim and Lane (2013) it has shown that there is a positive relationship between government health expenditure and life expectancy at birth. In contrast they stated that there is a negative relationship between government health expenditure and infant mortality rate.

Howdona and Rice (2018) in their study stated that health care expenditures is determined by proximity to death rather than age and that proximity to death is itself a proxy for morbidity.

Depending on this, studies on the relationship between infant mortality rate and health expenditures are also observed in the literature. Wang's (2002) study showed that factors affecting child mortality significantly differ in urban and rural areas. Demographic and Health Survey (DHS) data from over 60 low-income countries between 1990-1999 showed that was negative association between the level and inequality in child mortality. There is also important difference in child mortality between urban and rural areas, with rural population having a much slower reduction in mortality. Gallet and Doucouliagos (2017) stated that health expenditures have a significant effect on mortality compared to life expectancy. Sayılı et al. (2017) in their study suggested that Turkey is quite lower compared to the OECD countries average in the life expectancy in women and men. Moreover it is higher in neonatal, maternal and under-five mortality rates. In Bayın's (2016) study was concluded that the most influential variable in the life expectancy expected in both men and women was the infant mortality rate. Health expenditures per person and health service usage levels are among the variables that have the most impact on the life expectancy

expected at the age of 65. Tüylüoğlu and Tekin (2009) shows that life expectancy at birth and infant mortality rates are more affected than health expenditures. It is also states that the increase in income is not only a reliable factor. Kızılkaya et al. (2017) found a positive correlation between lifestyle and health expenditures at birth. According to this, 1 percentage point increase in the percentage of health expenditures in GDP will increase the life expectancy at birth by 0.53 units. In addition, a negative correlation was found between infant mortality and health expenditures. According to Arslanhan (2010), Turkey converges to the EU-15 average considering health expenditures. It also converges, including basic health indicators. While health expenditures and life expectancy increased in Turkey during the 1980-2008 period, infant mortality rate decreased significantly. Nixon and Ulmann (2006) in their study showed that increases in health care expenditure are considerably as sociated with majör improvements in infant mortality however only marginally in relation to life expectancy. Rahman (2018) stated that total health expenditure, public health expenditure and private health expenditure importantly reduced infant mortality rates, in addition the scope of effect of private health expenditure was greater than that of public health expenditure.

Finally we can approach the studies on the factors affecting the life expectancy in the literature. For example, Kabir (2008) in his study stated that none of the factors such as income per capita, education, health expenditures and urbanization were effective in determining expected life expectancy. Halicioglu (2011) in his study suggest that nutrition and food availability along with health expenditures are the main positive factors for improving longevity whereas smoking seems to be the main cause for mortality. Teker et al. (2012) in their study, the relationship between life expectancy of men and women in Turkey and socio-economic variables are examined. The effect of demographic and economic factors such as the ratio of health expenditures to GDP, the ratio of elderly to employable population, the number of hospital beds per thousand people, the number of doctors per thousand patients are analyzed. It has been found that each factor studied has a significant effect on the life expectancy of men and women. Fayissa and Gutema (2005) in their study examines the determinants of health status in SSA based on the Grossman (1972) theoretical model which considers the economic, social and environmental factors. Results showed that a decrease in illiteracy rate and an increase in the food availability index are well positively associated with improvements in life expectancy at birth. Khosroshahi's (2018) study stated that the most important determinants of rough birth rate and expected life expectancy were per capita health expenditures, per capita income and unemployment rate. Riumallo-Herl et al. (2018) proposed that poverty-free life expectancy (PFLE) as a new metric. They said that differences in PFLE between countries are considerably greater than differences in life expectancy. Also in 67 countries, the difference between life expectancy and PFLE was greater for females and women usually live more years of life in poverty.

Alptekin and Yeşilaydin in their study aims to determine health efficiencies of OECD countries. The data of 34 countries and Turkey have been compared in order to determine the current status of Turkey in relation to the variables identified. Among the results; Turkey is health expenditure per capita is at least the first (according to the purchasing power parity, usd), the expected life expectancy at birth is the second lowest; the maternal mortality rate is the fourth highest.

EMPIRICAL APPLICATION

Data and Methodology

The variable names and resources used in our study are given in Table 3. In addition, 22 OECD (Organization for Economic Co-operation and Development) countries with data from 1980-2017 were analyzed in this study. In this context, the ratio of infant mortality rates and health expenditures in GDP was taken as a variable from OECD statistics (OECD, 2019). In the literature, it is assumed that the attitudes and behaviors of the people about health and the policies implemented by the states towards health will increase the life expectancy of the individuals (average life expectancy) and decrease the infant mortality rates (Bayın, 2016; Tüylüoğlu and Tekin, 2009). In this respect, life expectancy at birth and

infant mortality rates are frequently used as health indicators in the literature. In addition, in the literature, variables such as the share of health expenditures in GDP, per capita health expenditures, population growth rate, birth rate, death rate, total fertility rate are also used (Kızılkaya et al., 2017). Based on the literature, our study assumed that healthy individuals would live longer and accepted that infant mortality rates are an important indicator for a healthy population. Therefore, infant mortality rates were used as a variable in our study.

Our study examines the relationship between health expenditures and infant mortality rates in the dimension of causality and cointegration. In order for causality or cointegration, variables have to be subjected to unit root test. The unit root test of the variables is given in Table 4. In this study, as the Panel Causality Test, Dumitrescu-Hurlin Panel Causality and Cointegration Test were also taken as Kao-Cointegration test.

Table 3: Definition of Variables Used and Data Sources

Variable	Definition	Data Source
Health Expenditure (HEXP)	Ratio of Health Expenditures in GDP	OECD (https://data.oecd.org/healthres/health-spending.htm
Infant Mortality Rates (INFMOR)	The infant mortality rate is defined by OECD as the number of deaths of children under one year of age, expressed per 1 000 live births.	OECD (https://data.oecd.org/healthstat/infant-mortality-rates.htm)

Unit Root Test

The unit root test is a test that gives result about whether any series is stationary. If there is no stability in a time series, then it is formulated as a serial $\Delta = X_t - X_{t-1}$ and is taken different until it becomes stable. If there is no stationarity in a time series, then it is formulated as a serial KX and is taken different until it becomes stationarity. When the time series becomes stationary, it is stated that this series is integrated at a level Δ. In addition, the stability of the series is shown in $X \sim I(\Delta)$ format. In the literature, Levin et al. (2002), Im at hand. (2003), Maddala and Wu (1999), Choi (2001) 's work is generally accepted in measuring the stability tests in panel data models. In our study, LLC unit root test was used. As seen in Equation 1, LLC is basically based on the ADF test and is based on the assumption that the coefficient of autoregressive (ρ) is homogeneous. In the fixed parameter model, X, ie the error process, show to distributed independently between the variables (Levin et al., 2002; Sirvan & Alp, 2017).

$$\Delta y_{it} = \alpha_{0i} + \rho y_{it-1} + \varepsilon_{it} \quad (1)$$

In addition, based on equation 1, our unit root test hypotheses have established below. In the hypotheses, if the coefficient ρ is equal to 0, then the hypothesis H_0 is accepted and in Equation 1 emerge that y_{it-1} has a unit root. So it is seen that the series is not stationary. In this case, the difference of series must be taken for series to be stationary.

$$H_0: \rho = 0 \qquad ve \qquad H_1: \rho \neq 0$$

Panel Cointegration Test

Cointegration analysis is a test method that provides information about the existence of long-term relationships among serieses. Engle and Granger (1987), who stated that linear combinations of two or more non-stationary series could be stationary, made a significant contribution to the literature with co-integration analysis. Cointegration analysis can also be performed using panel data. In the panel cointegration analysis, a method developed by Pedroni, which we often encounter in literature, was used. This method is expressed in Equation (2) below. The existence of the relationship between x and y in this equation depends on the stationary of the Q residue, which is the error term. If the term error is stationary, there is a long-term relationship between x and y (Pedroni, 1999).

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} X_{2i,t} + \beta_{2i} X_{2i,t} + \cdots + \beta_{Mi} X_{Mi,t} + e_{i,t} \quad (2)$$

t =1,2,…,M; i =1,2,…,N; m= 1,2,…,M

In the equation above, α denotes the constant effect parameter, δ deterministic time trend, β slope coefficients, t observation number, i horizontal number, m variable number. In the Pedroni cointegration analysis, the cointegration relationship between Y and X variables is tested by the stationarity analysis for Q error terms. Pedroni (1999) developed seven different cointegration statistics be on the point of being four of the tests were in the group and three of the tests were between groups.

Kao (1999), which extends the cointegration analysis by using the method of Pedroni, has entered the literature. Kao (1999), using Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) type tests, discussed the cointegration tests in panel data in two ways. A cointegration test was developed by applying Augment Dickey fuller (ADF) and Dickey Fuller (DF) stationary tests to the error terms mentioned in Model 3. Here, the null hypothesis is established in the form there is no cointegration (H_0: ρ=1)

$$y_{i,t} = x_{i,t}\beta + y_{i,t}\delta + \varepsilon_{i,t} \quad (3)$$

Panel Causality Test

The causality test is a more powerful version of the cointegration test. Indicates a strong relationship between two or more variables. Dumitrescu Hurlin (2012) had been measured the causality test with the panel data and had been ensured that the literaround entered. Dumitrescu - Hurlin panel causality is a methodology for understanding the causal relationship between variables. Granger is considered to be an advanced version of causality analysis. The Dumitrescu - Hurlin panel causality analysis is shown below in Equation (4).

$$Y_{i,t} = a_i + \sum_{k=1}^{K} Y_i^k Y_{i,t-k} + \sum_{k=1}^{K} B_i^k X_{i,t-k} + \varepsilon_{i,t} \quad (4)$$

In this equation X and Y represent the variables. Therefore, the purpose of this method is to determine whether X is the main cause of Y. In addition, B is the coefficient of the variable and a constant term. Besides, Q symbol gives reference to error term and K gives information about optimal delay interval (Dumitrescu & Hurlin, 2012).

This method used in the panel data approach was also used in similar studies. Boubtane et al. (2013) conducted a panel causality analysis between unemployment and GDP in OECD countries. Menard and Weill (2016: 270) used panel causality analysis and examined the relationship between help and poverty. In the study of Hartwig (2010), panel causality was used to examine the relationship between health capital and economic growth. Dincer et al. (2018), the relationship between defense spending and growth was analyzed by Dumitrescu - Hurlin causality test. Adalı and Yüksel (2017) conducted the relationship between foreign direct investment and economic development in developing economies with Dumitrescu - Hurlin causality analysis. The same test application were used performed by Dinçer et al.

(2018) for the relationship among inefficient credit, industry and economic growth. The validity of Okun's law for countries with different levels of development were analysis by Yüksel and Oktar (2017) with this method. İn the study of Ersin (2018), the effect of exports on growth in MINT countries was analyzed with the causality test. Ersin and Ergeç (2018) 's relation between expenditure components and sectoral employment was also used in the causality test. In addition, Ersin and Baş (2019) examined the relationship between growth and social expenditure with causality. This method has also been taken into consideration in the effectiveness of research and development expenditures and efficiency of the banking sector (Yüksel, 2017; Dinçer et al., 2017; Dinçer et al., 2019a, b, c). Moreover, in the literature, the panel data method was used in many similar studies (Eroğlu &Kara, 2017; Yıldırım, 2016a; Yıldırım, 2016b; Kalkavan & Ersin, 2019).

Empirical Findings

Unit Root Test Results

The precondition for panel cointegration and panel causality analysis is that the series are stationary. In the Table 4 are shown the unit root test results of the series. In order to accept the series as stationary, at least three of the 4 unit root tests were considered as stationary. According to the results, health expenditures were stationary at the level in all panel unit root tests. In the unit root test, intercept and Trend measurement was performed at the level. When we look at the infant mortality rates, while the series level was only stationary according to LLC and PP, in others the unit root problem occurred. To eliminate this problem, the first differences of the series were taken and the series were became stationary.

Table 4: Panel Unit Root Test Results

Health Expenditure (HEXP)				
	Intercept and Trend			
	t- statistic I(0)	**Probabilty I(0)**	**t- statistic I(1)**	**Probabilty I(1)**
Levin, Lin & Chu	-1.93052	0.0268**	-	-
Im, Pesaran and Shin W-stat	-1.93157	0.0267**	-	-
ADF - Fisher Chi-square	61.2125	0.0170**	-	-
PP -Fisher Chi-square	63.2384	0.0110**	-	-
Infant Mortality Rate (INFANT)				
	İntercept and Trend		**İntercept**	
	t- statistic I(0)	**Probabilty I(0)**	**t- statistic I(1)**	**Probabilty I(0)**
Levin, Lin & Chu	-4.16464	0.0000	-7.71833	0.0000
Im, Pesaran and Shin W-stat	0.98637	0.8380	-13.8699	0.0000
ADF - Fisher Chi-square	35.4667	0.6744	265.111	0.0000
PP - Fisher Chi-square	104.762	0.0000	543.305	0.0000

Kao Cointegration Test Results

Cointegration is a method that gives information about the relationship between two variables. In our study, Kao cointegration analysis was taken into consideration. Because Kao is the more advanced version of Pedroni. The results of Kao cointegration are shown in Table 5. According to the results, there is a long-term cointegration relationship between health expenditures and infant mortality rates. That is, the H_0 hypothesis (no cointegration between series) was rejected. Therefore, the alternative hypothesis (cointegration between series) was accepted.

Table 5: Kao Panel Cointegration Test Results

Kao Panel Cointegration Test Result		
	t- statistic	**Probabilty**
	-15.81340*	0.0000
ADF		
Residual variance	0.738369	
HAC variance	0.343039	

Dumitrescu-Hurlin Panel Causility Test Results

Dumitrescu - Hurlin causality analysis, an advanced version of Granger causality analysis, gives information about the causality of the relationship between variables. Table 6 shows the causality results.

Table 6: Panel Causality Test Results

The Direction of Causal Relationship	**Lag Value**	**Prob.**	**H_0**	**Result**
From Health Expenditures to Infant Mortality	1	0.0000	Health Expenditure does not homogeneously cause İnfant Mortality	Accept
	2	0.0000		Accept
	3	0.0473		Accept
From Infant Mortality to Health Expenditures	1	0.4911	İnfant Mortality does not homogeneously cause Health Expenditure	Reject
	2	0.9528		Reject
	3	0.4157		Reject

When we examine the causality relationship between the health expenditures and the infant mortality rates in Table 6, the probability value of all the lag values emerged less than 0.05 and the test statistics were found to be statistically significant. The null hypothesis from health expenditures to infant mortality rates was rejected. The fact that all three of the lag values are meaningful also reinforces the reliability of the results. Thus, it is concluded that health expenditures are the cause of infant mortality rates.

When the causality relationship between health expenditures in infant mortality rates is examined in Table 6, the probability values in all of the lag values were higher than 0.05 and test statistics were meaningless. Infant mortality rates did not emerge as a cause of health expenditure.

CONCLUSION

The increase in health expenditures positively affects the life expectancy and quality of individuals. The economic situation in the country is a factor determining the importance given to health development and the resources to be allocated. In this context, the development of health expenditures in the world may show differences among countries. While health expenditures are realized at a higher rate in developed countries, it is seen that health expenditures are realized at a low rate in less developed and developing countries. When the health expenditures of OECD countries are analyzed, the share of health expenditures in GDP increased from 6% to 9% from 1970 to the present. This means that OECD countries increase health expenditures and the health status of society increases.

One of the important indicators of health expenditures is infant mortality rates. In this study, the effect of health expenditures on infant mortality rates was examined and 20 OECD countries with data between 1980 and 2017 were analyzed. In the study using Kao Cointegration and Dumitrescu-Hurlin Causality tests, a long-term relationship was found between health expenditures and infant mortality rates in OECD countries. In addition, the causality relationship was determined from health expenditures to infant mortality rates. According to these results, the increase in health expenditures in OECD countries reduces infant mortality rates. Therefore, the continuation of health investments is important in reducing infant mortality rates in terms of the formation of a healthy population. To further reduce infant mortality in OECD countries, it is important to invest in healthcare in the light of long-term analysis. This will undoubtedly contribute to economic growth and development.

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