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RESEARCH PAPER

Examining the Impact of Income, Population Ageing, and Environmental Quality on Healthcare Expenditure in OPEC Member Countries

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Abstract

The rising cost of healthcare in countries poses a growing threat to the sustainability of healthcare systems and the fiscal stability of governments. As a result of economic development, increased life expectancy, population ageing, and decline in environmental quality, the geriatric population is exposed to air pollution for an extended period of time. This increases the demand for medical services and long-term care, as well as the increased expenditure on healthcare. This study investigates the effect of income, population ageing, and environmental quality on healthcare expenditure in OPEC member countries from 2000 to 2020 using the panel data method. According to the results, urbanization, life expectancy, and population ageing, as well as increased disability and underlying maladies, increase the demand for medical care and the associated costs. Also, the elasticity of healthcare expenditure based on GDP per capita is less than one. Therefore, health services are considered essential goods in OPEC member countries. In addition, the decline in environmental quality and the long-term exposure of the elderly population to air pollution have led to increased healthcare expenditure that threatens the financial and healthcare systems of the government.

Keywords: Ageing of the Population, Expenditure of Healthcare, Life Expectancy, OPEC, Quality of Environment.

JEL Classification: C23, H51, I19, Q52.

1. Introduction

Since the 1970s, healthcare expenditure has been the focus of economists, and one of the challenges in the discipline of health economics is to identify the factors that influence healthcare expenditures. These expenditures play an essential role in the health of people and the economic development of countries (Fogel, 2004). In developed and developing countries, the correlation between economic growth and healthcare expenditures is positive (Braedle and Colombier, 2016; Murthy and Okunade, 2016; Lopreite and Mauro, 2017; Lopreite and Zhu, 2020). Specifically, economic expansion and a rise in income increase the demand for medical services. In addition, increasing rates of chronic diseases (such as cardiovascular diseases, cancer, chronic kidney disease, diabetes, and their related complications) in senior age groups increase the demand for long-term healthcare services, such as costly technologies and hospitalizations that jeopardize the viability of healthcare systems (Murthy and Ukpolo, 1994; Feng et al., 2020). Also, people's life expectancy rises with economic growth, urbanization expansion, and the enhancement of medical and health services. Consequently, the increase in life expectancy as one of the indicators of health status also results in increased healthcare expenditures (Werblow et al., 2007; Harper, 2014). In contrast, increased healthcare expenditures result in greater availability of medical products and long-term health services, as well as increased life expectancy (Kunze, 2014). As the life expectancy of the elderly increases, so does the duration of infirmity and underlying disease, which increases the elderly's need for medical care and their healthcare expenses (Borrescio-Higa and Valenzuela, 2021). The level and structure of social costs are also affected by demographic patterns, and the demographic pressures of an ageing population increase the demand for medical services (Heller et al., 1986). Economic and social development, a decline in mortality rate, increased life expectancy, and a decline in fertility rate of women have resulted in structural changes in the population and compelled many nations to transition into a geriatric society (Wang et al., 2022). There is concern that the demographic pressures induced by the ageing of the population will lead to an unsustainable increase in public spending. Ageing and urbanization are global demographic patterns with significant social, economic, and political implications (Leeson, 2018). The increase in the geriatric population in various nations and their increased use of health services drives up healthcare costs (Manski et al., 2013; Choi and Shin, 2015; Uddin et al., 2016; Lopreite and Zhu, 2020). The Organization for Economic Co-operation and Development (OECD) predicts that by 2050, Europe's age-related social costs will increase from approximately 19% of GDP in 2000 to approximately 26%. More than half of this increase is attributable to pensions and costs associated with the elderly's health and long-term care (Dang et al., 2001). If population ageing coincides with deteriorating health at older ages, public expenditures will be further impacted. According to

United Nations statistics, the percentage of the world's geriatric population (those aged 65 and older) has increased by 3.16% over the past 30 years and approached 10% by 2020. In 2021, the global elderly population increased to 2.723 million persons. It is anticipated that by 2050, the global population of senior citizens will reach 1.5 billion (United Nations, 2023). Economic prosperity and urbanization expansion are linked to the degradation of the environment and the emission of pollutants. In the theoretical literature, the quality of the environment also affects healthcare expenditures, and there is consensus in this field (Narayan and Narayan, 2008; Apergis et al., 2018c; Zaidi and Saidi, 2018), whereas less literature concentrates on the opposite relationship. Sami and Chokri (2014) confirmed a stable, long-term relationship in Tunisia between healthcare expenditure per capita, population ageing, healthcare, GDP, and environmental quality. Ahmad et al. (2021b) demonstrated a bidirectional causal relationship between CO2 emissions and the increase in healthcare costs in 27 Chinese provinces.

This study examines the impact of income per capita, population ageing, and environmental quality on healthcare expenditure in OPEC member countries[1] from 2000 to 2020 using the panel data method. The novelty of this research is to examine the interactive effect of population ageing and life expectancy, the interactive effect of the urban population and life expectancy, and the interactive effect of urban population and carbon dioxide emissions on the per capita healthcare expenditure per capita.

Section 2 provides the literature review and research background. In Section 3, the model is described, and the data are reported. Section 4 presents the model estimation and analyzes the results. Finally, in section 5, the results and policy recommendations are presented.

2. Literature Review

Newhouse (1977) was the first to investigate the factors affecting the cost of healthcare in selected countries that are members of the OECD and concluded that the income of the communities is the most significant factor affecting the cost of healthcare in these countries. In this regard, numerous studies have investigated the correlation between healthcare costs and economic growth or per capita income. Gerdtham et al. (1992) demonstrated that GDP per capita significantly explained the variation in healthcare costs across 19 OECD countries. Wang (2011) analyzed the causal relationship between the increase in healthcare costs

[1]. OPEC member countries include Algeria, Iran, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, United Arab Emirates, Ecuador, Angola, Venezuela, and Congo.

and economic growth using data from 31 countries from 1986 to 2007. According to the findings of Amiri and Ventelou (2012), there is a two-way Granger causality between GDP and healthcare costs in OECD nations. Braendle and Colombier (2016) demonstrated a correlation between per capita income and the growth of healthcare expenditures. Amiri and Linden (2016), using data from 22 OECD countries from 1970 to 2012, discovered that the bidirectional relationship between GDP and total healthcare costs is prevalent in the overwhelming majority of countries. Halici-Tuluce et al. (2016) found a reciprocal relationship between healthcare expenditures and economic growth for both low- and high-income economies. Chaabouni et al. (2016) detected a bidirectional relationship between healthcare expenditure and economic growth in 51 low-, middle-, and high-income countries from 1995 to 2013. Other studies in developed and developing countries have found a positive correlation of healthcare costs with economic growth and income (Lopreite and Mauro, 2017; Lopreite and Zhu, 2020).

The level and structure of social costs are also affected by demographic patterns, so that the demographic pressures of an ageing population increase the demand for medical services (Heller et al., 1986). The increase in the geriatric population in various nations and the increased utilization of health services by this group cause a rise in healthcare expenditures (Hosoya, 2014). Manski et al. (2013) indicated that the use of medical care and visits to care centers is on the rise among the elderly in the United States. Ageing is associated with a decline in physical abilities and the development of chronic and underlying diseases. If the ageing of the population coincides with a decline in health as people age, medical expenses will rise. As the life expectancy of the elderly increases, so will the duration of disability and underlying disease, increasing the elderly's need for medical care and their healthcare expenses (Borrescio-Higa and Valenzuela, 2021). Increasing the frequency and duration of health service use, as well as increasing the cost of medication, treatment, and rehabilitation for the elderly relative to other age groups, causes increased healthcare costs (Jenson, 2007). Additionally, the increase in the elderly population increases the government's healthcare expenditures and contributes to a rise in the government budget deficit (Derek and Chen, 2004; Kluge, 2013). Izadkhasti and Balaghi Inalo (2018) examine the effects of the allocation of government expenditure to the health sector and prevention of pollution in an endogenous growth model. Consequently, the increased demand for medical services and care among this age group primarily affects the government's financial instability (Lopreite and Zhu, 2020; Jia et al., 2021). Therefore, the government can allocate resources to address the negative effects of ageing by implementing appropriate policies or by predicting future population age changes (Auerbach, 2012). Murthy and Okunade (2016), using annual data from 1960 to 2012 and an autoregressive distributed lag (ARDL) approach, identified real per capita income, the proportion of the population over 65 years old, and the level of healthcare technology as the primary drivers of per capita healthcare expenditure. Izadkhasti et al. (2017) analyzed the effects of green taxes on emissions of pollution and health index in Iran, using a two-stage least squares technique and system of simultaneous equations, during the period (1989-2014). The results indicate that the green tax will reduce pollutants. Also, simultaneously reducing emissions of pollution will increase the health index. Jia et al. (2021), using gray system theory, examined the degree of correlation between healthcare expenditures, population ageing, and economic conditions from 2000 to 2018 in China. The results indicated that the government and society of China played a significant role in reducing the medical burden of residents. In addition, the recovery of the economy and the ageing of the population have increased the demand for health services. The OECD predicts that by 2050, Europe's age-related social costs will increase from approximately 19% of GDP in 2000 to approximately 26%. More than half of this increase is attributable to pensions and costs associated with the elderly's health and long-term care (Dang et al., 2001).

On the other hand, with economic, social, and urban development, life expectancy has also increased. However, with the discharge of pollutants, the quality of the environment has decreased, leading to an increased elderly population with underlying diseases. This has ultimately resulted in a rise in healthcare demand and costs. In this regard, Linden and Ray (2017) discovered a positive relationship between public healthcare expenditures (particularly private expenditures) and life expectancy for 34 OECD countries between 1970 and 2012 using the panel data method. Lopreite and Mauro (2017) applied Bayesian Vector Autoregression (B-VAR) models from 1990 to 2013 in Italy and concluded that healthcare expenditures responded more to the population ageing index than to life expectancy and economic development. Gallet and Doucouliagos (2017), using meta-regression analysis, detected evidence that the mortality rate has a greater effect on healthcare costs than life expectancy. Lopreite and Zhu (2020), using Bayesian Vector Autoregression (B-VAR) models, examined the effects of population ageing on healthcare costs and economic growth in China and the United States from 1978 to 2016. The results indicated that economic growth encourages healthcare expenditures and that increasing life expectancy contributes to a rise in the ageing index in China and the United States. Moreover, the significance of the population ageing index on healthcare expenditure and GDP is greater in China than in the United States. Linden and Ray (2017) divided 34 OECD countries into three categories based on public spending as a percentage of GDP, and discovered a positive correlation between public healthcare spending and life expectancy in countries with a larger proportion. Liu (2020) examined the relative importance of ageing in increasing healthcare costs by examining diabetes care costs in Taiwan, and found that approximately 75% of the variation in diabetes care costs was attributable to the effects of population ageing.

The decline in environmental quality and the discharge of pollutants have exposed the elderly to underlying diseases, thereby increasing the demand for healthcare and treatment. Gerdtham et al. (1992) investigated for the first time the impact of air pollution on healthcare costs in Canadian provinces. There is consensus in the theoretical literature regarding the relationship between environmental quality and healthcare expenditures (Narayan and Narayan, 2008; Apergis et al., 2018c; Zaidi and Saidi, 2018), whereas less research has been conducted on the inverse relationship. Accordingly, the long-term exposure of the elderly population to air pollution increases the cost of healthcare. In some previous studies, urban populations have been the primary focus, and the statistical power to estimate health effects in other groups is insufficient (Di et al., 2017). In Tunisia, Sami and Chokri (2014) confirmed a stable long-run relationship between healthcare expenditure per capita, population ageing, healthcare density, GDP, and environmental quality. Ahmad et al. (2021b) found a bidirectional causal relationship between CO2 emissions and the development of healthcare expenditures in 27 Chinese provinces. Apergis et al. (2018a) confirmed that consumption of renewable energy and healthcare expenditure decreased CO2 emissions in 42 sub-Saharan African nations. In addition, they proposed increased funding for renewable energy and healthcare initiatives. Wu (2019) analyzed the footprint of China's healthcare system using the environmental extended input-output technique. The results indicated that China had a smaller carbon footprint per capita for healthcare than developed nations, but comparatively higher emissions per unit of healthcare expenditure.

The novelty of this research is to examine the interactive effect of population ageing and life expectancy, the interactive effect of the urban population and life expectancy, and the interactive effect of urban population and carbon dioxide emissions on the per capita healthcare expenditure per capita.

3. Methods and Materials

As a result of economic development, increased life expectancy, population ageing, and decline in environmental quality, the geriatric population is exposed to air pollution for an extended period of time. This increases the demand for medical services and long-term care, as well as the increased expenditure on healthcare. Therefore, following Lopreite and Mauro (2017), Lopreite and Zhu (2020), Ahmad et al. (2021b), and Wang et al. (2022), we examine the effect of population ageing and environmental quality on healthcare expenditure in OPEC member countries using the panel data method over the period of 2000 to 2020.

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} + \beta_3 LLE_{it} + \beta_4 LUB_{it} + \beta_5 LCO2_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

Where LHE_{it} is the logarithm of healthcare expenditures per capita (at current prices), $LGDPP_{it}$ is the logarithm of GDP per capita (at constant 2015 prices), LAP_{it} is the logarithm of the population aged 65 and over, LLE_{it} is the logarithm of life expectancy at birth, LUB_{it} is the logarithm of the urban population (as a percentage of the total population), and $LCO2_{it}$ is the logarithm of carbon dioxide emissions per capita in i^{th} country in time period t. η_i stands for individual effects, while ε_{it} stands for the error term. In Equations 2 through 5, the interactive effect of urbanization and life expectancy, the interactive effect of urbanization and carbon dioxide emissions, the interactive effect of population ageing and carbon dioxide emissions, and the interactive effect of population ageing and life expectancy are tested on per capita healthcare expenditure, respectively:

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} + \beta_3 LUB_{it} * LLE_{it} + \beta_4 LCO2_{it} + \eta_i + \varepsilon_{it} \quad (2)$$

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} + \beta_3 LUB_{it} * LLE_{it} + \beta_4 LCO2_{it} + \eta_i + \varepsilon_{it} \quad (3)$$

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} + \beta_3 LLE_{it} + \beta_4 LUB_{it} * LCO2_{it} + \eta_i + \varepsilon_{it} \quad (4)$$

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} * LCO2_{it} + \beta_3 LLE_{it} + \beta_4 LUB_{it} + \eta_i + \varepsilon_{it} \quad (5)$$

$$LHE_{it} = \alpha_i + \beta_1 LGDPP_{it} + \beta_2 LAP_{it} * LLE_{it} + \beta_3 LUB_{it} + \beta_4 LCO2_{it} + \eta_i + \varepsilon_{it} \quad (6)$$

The data of OPEC member countries were obtained from the website of the World Bank. Libya and Venezuela have been eliminated due to the absence of data for certain variables. The estimation of the model is performed using the panel data model and STATA 17 software. The variables are described in Table 1.

Table 1. Description of Variables

Variable	Symbol	Definition	Source
Healthcare expenditure	HE	Healthcare expenditure per capita (current US$)	(WDI[1], 2022)
GDP per capita	GDPP	GDP per capita is gross domestic product divided by midyear population (constant 2015 US$)	(WDI, 2022)
Ageing population	AP	Population ages 65 and above	(WDI, 2022)
Life expectancy	LE	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	(WDI, 2022)
Urbanization	UB	Urbanization rate is the measurement index of urbanization, which generally adopts a demographic index, namely the proportion of urban population in the total population (%)	(WDI, 2022)
Carbon dioxide emissions per capita	CO2	Regional carbon dioxide emissions (metric tons per capita)	(WDI, 2022)

4. Results and Discussion

Before analyzing the relationship between the variables, the variables' stationarity ought to be examined with unit root tests. In panel data models, the Levin-Lin-Chu (LLC) test, the Im-Pesaran-Shin (IPS) test, the Breitung test, the Fisher-ADF test, and the Hadri LM test are applied. Results are reported in Table 2. The unit root tests were done with an individual intercept for each variable, and the optimal lag length was selected automatically using the Schwarz Information Criterion (SIC). According to Levin-Lin-Chu and Hadri LM test, all variables are stationary at 1 %, level. Also, Life expectancy and Urbanization, based on all unit root tests, are stationary.

[1]. World Bank Database

Table 2. Panel Unit-Root Tests for Variables

Variables	LLC	Breitung	IPS	Fisher- ADF	Hadri
Ln (Healthcare expenditure per capita)	-4.63	3.08	-1.68	13.80	25.16***
Ln (Ageing population)	-12.26***	6.94***	-3.05***	19.94	28.14 ***
Ln (GDP per capita)	-6.20***	5.16***	-1.61	26.44	20.77***
Ln (Life expectancy)	-7.70***	8.65***	-2.23**	43.26***	35.95***
Ln (C02 per capita)	-5.38***	2.07	-1.41	7.13	14.53***
Ln (Urbanization)	-4.66***	7.55***	-60.34***	189.8***	26.5***

Source: Research finding.

Note: The unit root tests were done with an individual intercept for each variable. The optimal lag length was selected automatically using the Schwarz Information Criterion (SIC). *, **, and *** are significant at the 10%, 5 % and 1 % level, respectively.

To avoid spurious relationships and ensure the existence of a long-term relationship between variables, panel cointegration tests provided by Pedroni (1999, 2004) are applied, where the null hypothesis indicates the absence of cointegration between model variables. This method estimates cointegration regression separately for each country. The null hypothesis is rejected at a significance level of 10% based on the rho and ADF statistics of the panel in Table 3, and there is a long-term relationship between the variables of the model.

Table 3. Pedroni Cointegration Test

Test Stats	Panel-stats	Group-stats
v-stat	0.777	-
rho-stat	1.856*	3.227*
t-stat	-0.8944	-0.3399
ADF-stat	-2.183*	-1.714*

Source: Research finding.

Note: The data has been time-consuming. All test statistics have an N(0,1) distribution under the null hypothesis of no cointegration. *, is significant at the 10%, level.

Table 4 provides descriptive statistics of research model variables, such as mean, maximum, minimum, and standard deviation for ten OPEC member nations from 2000 to 2020. The dependent variable in this study is the logarithm of healthcare expenditures per capita, while the independent variables are the logarithms of GDP per capita, the population aged 65 and over, life expectancy, carbon dioxide emissions per capita, and the percentage of urban population.

Table 4. Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
Ln Healthcare expenditure per capita	210	5.684	1.293	2.564	**7.6166**
Ln Ageing population	210	12.676	1.763	8.998	**15.640**
Ln GDP per capita	210	9.106	1.199	7.369	**11.204**
Ln Life expectancy	210	4.262	0.120	3.829	**4.394**
Ln C02 per capita	210	1.445	1.945	-3.515	**3.863**
Ln Urbanization	210	4.263	0.260	3.558	**4.605**

Source: Research finding.

Note: Mean is the average, Std is the standard deviation, Min is the minimum, and Max is the maximum.

Figure 1 depicts the trend of healthcare expenditures (%GDP), and Figure 2 shows the trend of the population aged 65 and older (%POP) in OPEC member countries during the period 2000-2020.

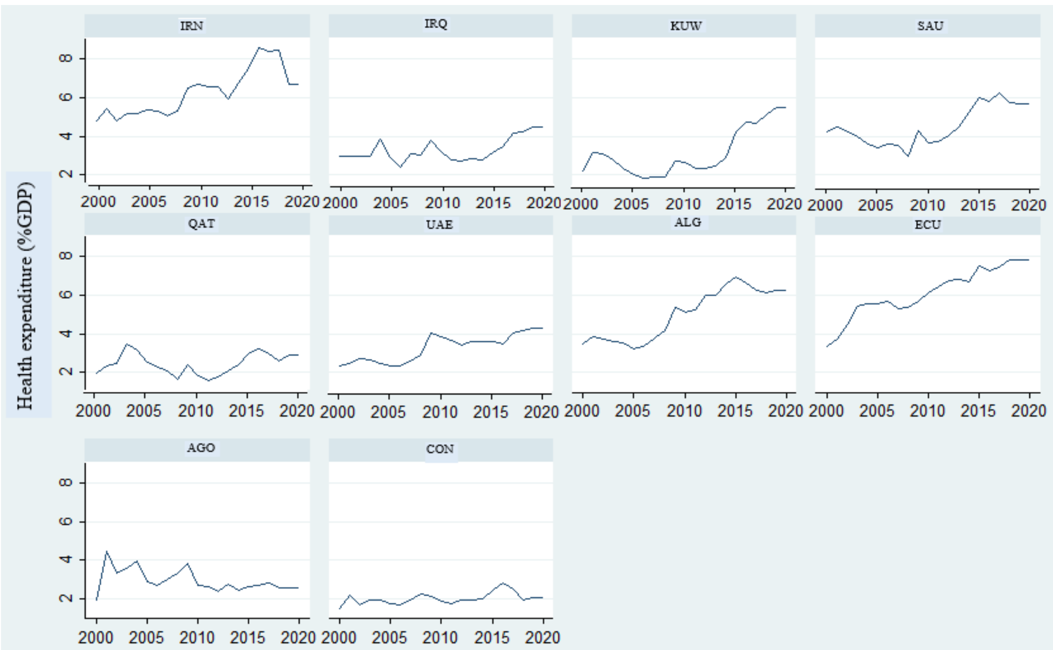

Figure 1. Healthcare Expenditure Trends (%GDP) in OPEC Member Countries between 2000 and 2020

Source: Research finding.

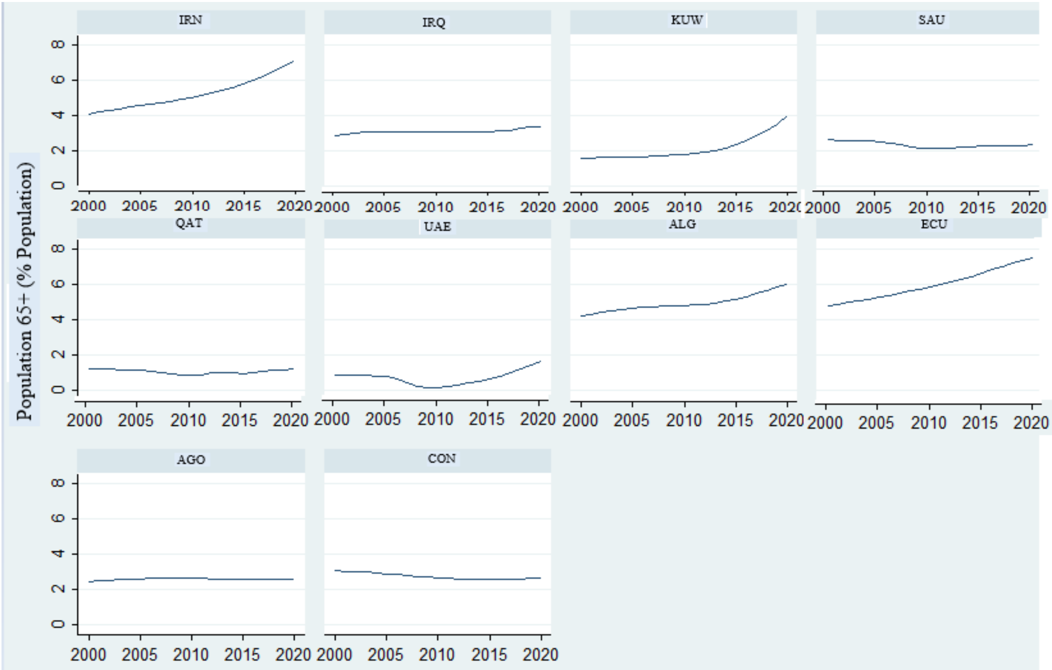

Figure 2. Population Trend of 65 Years and Older (%POP) in Selected Countries between 2000 and 2020

Source: Research finding.

The F-Limer test is utilized to distinguish between pooling and panel data. The null hypothesis is rejected at a significance level of 1% using the F-test across multiple models, and the statistical data is confirmed to be panel data, as shown in Table 5. Also, the null hypothesis is rejected at the 1% level based on the results of the Hausman test, and the estimation confirms the model of fixed effects versus random effects. According to the results obtained, the increase in GDP per capita raises the cost of healthcare expenditure per capita. In models 1 through 5, the income elasticity of healthcare expenditure was 0.611, 0.667, 0.402, 0.557, and 0.720, respectively, and all of which are less than one. Consequently, healthcare facilities are necessary goods in OPEC member countries. This result is consistent with previous research findings in this field. Amiri and Ventelou (2012) discovered a two-way Granger causality between GDP and healthcare expenditures. Braendle and Colombier (2016) demonstrated a correlation between per capita income and the growth of healthcare expenditures. Amiri and Linden (2016) exhaustively determined the bidirectional relationship between GDP and total healthcare expenditures. In the short-term, Halici-Tuluce et al. (2016) demonstrated a reciprocal relationship between healthcare expenditures and economic growth for both low-income and high-income economies in their sample. Chaabouni et al. (2016) discovered a bidirectional relationship between healthcare expenditures and economic growth in 51 low-, middle-, and high-income countries.

In models 1 to 3, a 1% increase in the population aged 65 and older has resulted in increases of 0.587%, 0.567%, and 0.593% in per capita healthcare expenditure, which are significant at the 1% level. Consequently, old age is associated with a decline in physical capabilities and chronic and underlying diseases, and as health declines with age, the treatment costs rise. These outcomes are consistent with those of Manski et al. (2013), Choi and Shin (2015), Uddin et al. (2016), Lopreite and Zhu (2020), and Borrescio-Higa and Valenzuela (2021).

In models 1, 3, and 4, an increase of 1% in life expectancy led to increases of 2.782%, 5.169%, and 10.633% in healthcare expenditure per capita, respectively. Life expectancy increases as a result of economic development and the enhancement of medical and healthcare services. These results are consistent with those of Werblow et al. (2007), Harper (2014), and Linden and Ray (2017). Considering that economic and social development and increased life expectancy result in population structure changes (Wang et al., 2022), ultimately, this will increase healthcare and medical costs. In this regard, the estimated coefficient for the interactive effects of life expectancy and population ageing with healthcare costs was calculated to be 0.139.

In models 1, 2, and 5, an increase of 1% in per capita carbon dioxide emissions led to increases of 0.905%, 0.864%, and 0.825% in per capita healthcare costs, respectively. This result is consistent with findings of Narayan and Narayan (2008), Apergis et al. (2018c), and Zaidi and Saidi (2018). Ahmad et al. (2021b) also found a two-way causal relationship between CO_2 emissions and the increase in healthcare costs. With the growth of urbanization and the increase in urban population, carbon dioxide emissions also increase. On the basis of this information, the interactive effect of urbanization and carbon dioxide emission on the per capita cost of healthcare has been analyzed, and its estimated coefficient is 0.266.

In models 1, 4, and 5, a one percent increase in the urban population led to an increase in healthcare expenditure per capita of 2.168%, 4.802%, and 2.944%, respectively. Because economic, social, and urbanization development also increase life expectancy and healthcare costs, the estimated coefficient for the interactive effect of urban population and life expectancy on healthcare expenditure per capita has been calculated as 0.618.

Table 5. Results of Fixed Effects Regression Estimation

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
LnGDPP	0.641** (0.246)	0.667** (0.225)	0.402* (0.239)	0.557** (0.218)	0.720*** (0.227)
LnAP	0.587*** (0.078)	0.567*** (0.079)	0.593*** (0.076)	-	-
LnLE	2.782** (1.291)	-	5.169*** (0.689)	10.633*** (1.291)	-
LnCO2	0.905*** (0.244)	0.864*** (0.226)	-	-	0.825** (0.234)
LnUR	2.168* (1.137)	-	-	4.802*** (1.218)	2.944*** (0.694)
LnUR∗LnLE	-	0.618*** (0.082)	-	-	-
LnUR∗LCO2	-		0.266*** (0.052)	-	-
LnAP∗ LCO2	-	-	-	0.322 (0.205)	-
LnAP∗LnLE	-	-	-	-	0.139*** (0.205)
C	-30.021*** (2.705)	-20.091*** (1.932)	-29.30*** (2.583)	-66.910*** (4.911)	-22.139*** (2.968)
F test*	F(9, 195) = 10.06***	F(9, 196) = 10.48***	F(9, 196) = 14.07***	F(8, 159) = 17.85***	F(9, 196) = 10.13***
Hausman test	10.06***	29.60***	34.84***	61.30***	37.20***
Observations	210	210	210	210	210
Number of countries	10	10	10	10	10
	Within = 0.65 Between = 0.75 Overall = 0.68	Within = 0.65 Between = 0.77 Overall = 0.70	Within = 0.56 Between = 0.96 Overall = 0.88	Within = 0.65 Between = 0.87 Overall = 0.79	Within = 0.64 Between = 0.76 Overall = 0.69

Source: Research finding.

Note: The figures enclosed in parentheses beneath the regression coefficients represent standard errors. *, **, and *** are significant at the 10%, 5%, and 1% levels, respectively. The dependent variable is the logarithm of health expenditure per capita (current US$). The ageing population, GDP per capita, life expectancy, per capita CO2 emissions, and urbanization are all expressed in natural logarithms.

5. Conclusion and Policy Recommendation

Identifying the factors that affect healthcare costs is one of the challenges of health economics. In both developed and developing countries, economic growth and income are positively correlated with healthcare costs. Additionally, the rise in income increases the demand for medical services. Increasing rates of chronic diseases (such as cardiovascular disease, cancer, chronic kidney disease, diabetes, and their related complications) and long-term exposure to air pollution increase the demand for long-term healthcare services, such as technologies, among senior age groups. Hospitalization becomes costly, putting the sustainability of healthcare systems at peril. Population ageing, increased life expectancy, the growth of urbanization, and a decline in environmental quality due to increased environmental pollutants influence the level and structure of social costs and healthcare costs. This study investigates the effects of population ageing, environmental quality, and income per capita on healthcare costs per capita in OPEC member countries from 2000 to 2020. According to the findings, the rise in income per capita increases the demand for medical services. Due to the fact that the income elasticity of healthcare expenditures is less than one, health services are necessary goods in OPEC member nations. The increase in the geriatric population has led to an increased cost of healthcare per capita. Hence, old age is linked to a decline in physical capabilities and chronic and underlying diseases. If population ageing and health decline at older ages occur simultaneously, medical expenses will rise. Increasing life expectancy, combined with infirmity and underlying disease, increases the medical care requirements of the population. Based on this, the increasing frequency and duration of the elderly's use of health services, as well as the rising costs of medication, treatment, and rehabilitation, contribute to a rise in healthcare costs. As a consequence, the interaction between an aging population and life expectancy has led to increased healthcare expenditures. In addition, urbanization and the decline in environmental quality as a consequence of the increase in carbon dioxide emissions have exposed people to air pollution for an extended period of time and increased the per capita cost of healthcare. Also, the interactive effects of the rise in urbanization and life expectancy, as well as the interactive effects of the rise in urbanization and per capita carbon dioxide emissions, have increased the per capita cost of healthcare.

Considering the economic, social, and urban development, along with the ageing of the population, the increased life expectancy, and the decline in environmental quality in various societies, there has been an increase in the demand for long-term healthcare services, as well as increased public expenditures and healthcare costs. This threatens the viability of healthcare systems and has resulted in numerous economic, social, and political consequences and difficulties. Therefore, suggested that the government's implementation of practical and comprehensive policies and programs can mitigate the challenges posed by the ageing of the population, the decline in environmental quality, and their reciprocal effects on the rise in costs.

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