

NEXUS BETWEEN HEALTH DETERMINANTS AND HEALTH OUTCOMES: A COMPARATIVE GLOBAL ANALYSIS

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ABSTRACT

The present study examines the nexus between healthcare determinants and health outcomes of different income group countries.

For this, the study uses the Feasible Generalized Least Square (FGLS) model on a panel of 143 countries spanning from 2000 to 2019.

The findings suggest that total health expenditure and GDP per capita significantly improve health outcomes by reducing infant mortality and increasing life expectancy in all income groups and in all geographic regions. Further, socioeconomic determinants like urbanisation and sanitation significantly contribute to the improvement of health status.

Therefore, our results suggest that government health expenditures have to increase to enhance the health outcomes of different countries. At the same time, the policymakers have to focus to increase the income level of the people in order to enhance the health outcomes of the countries.

KEYWORDS

life expectancy at birth, infant mortality rate, health expenditure, FGLS, JEL codes: I10, I15, I18, C23

INTRODUCTION

The nexus between health determinants and health outcomes is a complex and multifaceted issue. The important determinants of health outcomes include well-known factors such as health expenditure [1, 2], income [2], education level [3, 4] and sanitation [5]. Recent empirical studies focus on the role of information and communication technology [6], income inequality [7] and ethnic diversity [8-10] on health outcomes of countries. Since last two decades, a large disparity in health outcomes has been apparent between rich and poor countries. For instance, World Population

Prospects 2022 reported that life expectancy at birth (LEB) in Sub-Saharan Africa is 59.7 years in 2021 and based on prediction, it might increase to 66.7 years in 2050. LEB in central and southern Asia was 67.7 years in 2021 and it is predicted to increase to 77.1 years in 2050. However, LEB in Europe and North America is 77.2 years in 2021 and it is predicted to increase to 83.8 years in 2050. In addition, Sub-Saharan countries are also leading the table in "infant mortality rate" (IMR), "maternal mortality rate" (MMR), and "crude death rate" (CDR). Such disparities in health outcomes across the different regions of the world are due to wide variations in the social, cultural, and economic characteristics of those regions. However, a significant amount of health expenditures, i.e., "government health expenditure" (GHE) or "private health expenditure" (PHE), can improve health outcomes and reduce health disparities between developed and developing countries [2, 11].

Previous studies [1, 12-15] did not find any consistent nexus between health expenditures and health outcomes. The key determinants of child mortality were not public healthcare spending but rather the depth of "poverty, income inequality, female education, and other socioeconomic factors" [12]. Additionally, a World Bank report on Indian states did not reveal no correlation between healthcare spending and infant mortality rate.

Carbon dioxide (CO₂) emissions are the principal origin of human-induced global warming and associated climate change, which is widely seen to be one of the most serious worldwide threats to human health [16]. In general, it may influence population health in the following manners. First, inhaling high concentrations of emissions directly harms the respiratory system of people, inducing headaches, shortness of breath, and even delirium [17]. Second, emissions may indirectly influence population health through climate change, which will lead to around 250,000 deaths each year over the period 2030–2050, according to the World Health Organization. On the one hand, increasing CO₂ emissions leads to global warming that changes the pattern and amount of precipitation and increases the intensity and frequency of extreme weather. On the other hand, by increasing air pollution and facilitating the propagation of climate-sensitive diseases, global warming will affect population health [18].

From the previously mentioned existing studies, our study differs in the following grounds. The present study provides the novelties such as; First, from the existing literature, we found that "the role of health expenditure on health outcome" only in country based either on income or on region, but in our study, we have made a comparative study on the impact of different health determinants on health outcomes between the income-based as well as region-based countries. In this case, the study has examined the differential effect of health determinants on IMR and LEB for various income group countries and also examined the differential regional effect on income group countries. Second, we have emphasised the effects of health determinants on two major health outcomes i.e., IMR & LEB. Third, we have used a novel FGLS model by capturing the heterogeneity of the countries through cross-section dependency. Next, the debate on the nexus between health determinants and health outcomes is indeterminate; the present study attempts to justify this discussion by offering a piece of new evidence from this comparative study.

The findings of the study show that total health expenditure and GDP per capita significantly improve health outcomes by reducing infant mortality and increasing life expectancy in all income groups. The study also finds the same results across all the geographic regions. Further, the study finds that other factors significantly contribute to the improvement of health outcomes. For instance, higher per capita income is associated with lower infant mortality and higher life expectancy at birth. Per capita income elasticities are higher than those of total health expenditure, suggesting that the impact of income level on health status is greater. In addition, urbanisation and sanitation also contribute to the reduction of infant mortality and in the increase of life expectancy at birth. However, CO₂ emission does not show a statistically significant relationship with two health outcomes.

The organisation of the remaining parts of the study is as such: Section 2 reports the literature review; Section 3 provides a brief overview of the health status outcomes of the countries based on region and income groups; Section 4 describes the methodology, data and model; Section 5 analyses empirical results; and finally, Section 6 concludes the paper with some policy suggestions.

LITERATURE REVIEW

A large body of literature reports the link between health determinants and health outcomes. These studies provide contrasting results between two variables i.e., health determinants and health outcomes. This may happen due to wide variations in cultural and economic characteristics across countries. The detailed literature has been explained below.

RELATIONSHIP BETWEEN HEALTH EXPENDITURE AND HEALTH OUTCOMES

There are many studies in the literature on the nexus between health expenditure and health outcomes. Anyanwu & Erhijakpor [19] studied the data from 47 African nations between 1999 and 2004 to study the association between government health spending and IMR and under-5 mortality. They found that there was a highly significant association between health expenditure and infant and under-5 mortality. Similarly, Novignon et al. [11] observed a significant inverse link between healthcare spending and IMR in 44 Sub-Saharan Africa (SSA) countries. Edeme [20] examined the effects of government health expenditure on health outcomes such as IMR and LEB in Nigeria from 1981 to 2014 and found that government health spending has a significant effect on health outcomes in Nigeria. In addition, Arthur & Oaikhenan [1] discovered a substantial inverse link between health spending and IMR for Sub-Saharan African (SSA) nations.

In the instance of industrialised nations, Crémieux et al. [21] examined the link between Canadian health spending and health outcomes over a 15-year period. Their research revealed a statistically significant link between lower healthcare spending and a rise in infant mortality. Similarly, Nixon & Ulmann [15] using a panel data set for the 15 EU members from 1980 to 1995, found that substantial reductions in infant mortality are significantly correlated with increase in healthcare spending. Similar to this, Berger & Messer [22] looked at the impact of health expenditures, health insurance, and other factors on health outcomes using panel data from 20 OECD nations. The study found that factors other than public spending had measurable positive influence on health outcomes. Furthermore, Kim & Lane [23] examined the link between public health expenditure and health outcomes among EU developing nations. They used OLS and 2SLS estimators to analyze the relationship between dependent and independent variables and found that public health expenditure and health outcomes are in a long-run equilibrium relationship and health expenditure can improve LEB. Similarly, several studies [9, 10, 24, 25] examined the role of health determinants on different regions.

RELATIONSHIP BETWEEN PER CAPITA INCOME AND HEALTH OUTCOMES

Some empirical studies found that per capita income is more significant in explaining the health outcomes. Vărzaru [26] investigated the determinants of infant mortality at the municipal level in Brazil covering the period from 1970 to 2000. They discovered that the drop in infant mortality in Brazil was largely due to improvements in per capita income, sanitation, and education. Bokhari et al. [27] linked per capita income to two health outcomes such as under-5 mortality (U5M) and maternal mortality (MM). They found that elasticity with respect to per capita income is -0.40 and -0.44 for U5M and MM, respectively, and both are statistically significant. Raeesi et al. [28] examined the link between per capita income and 3 health outcomes, such as LEB, IMR and U5M within 4 different health care systems for 25 countries between 2000 and 2015. They found that 1 unit increase in per capita income leads to 5.52 units increase in LEB, and -1.24, and -1.11 unit decrease in IMR and U5M respectively. Similarly, Rahman et al. [2] investigated the impact of per capita income on three health outcomes, such as IMR, CDR and LEB for 15 countries in the SAARC-ASEAN region over a 20-year period (1995-2014). They found that per capita income growth rate had a significant positive impact in improving LEB and reducing IMR in the region.

RELATIONSHIP BETWEEN CO₂ EMISSION AND HEALTH OUTCOMES

Matthew Oluwatoyin et al. [29] attempted to find the impact of carbon emission on LEB in Nigeria between 1979 and 2012. They used Johansen Co-integration and VECM techniques to establish long-run relationship between CO₂ emission and LEB. They found that carbon emission significantly deteriorates LEB in Nigeria. Farooq et al. [30] investigated the role of CO₂ emission in health issues on an unbalanced panel data of 30 Chinese provinces between 1996 and 2015. They found that health issues are increasing in all Chinese provinces with higher exposure to CO₂ emission. Matthew et al. [31] examined the long-run effect of greenhouse gas (GHG) on life expectancy in Nigeria employing time series data from 1985 to 2016 and found that 1% increase in greenhouse gas emission leads to 0.04% decline in life expectancy. Erdoğan et al. [32] analyzed the impact of carbon emissions on health indicators between 1971 and 2016 in Turkey. They found that a long run relationship exists between health indicators and carbon emissions. An increase in carbon emissions

reduces life expectancy and increases infant mortality rate. Omri et al. [33] investigated the impact of CO₂ emission on infant mortality and life expectancy in Saudi Arabia over the period 2000-2018. They discovered that CO₂ emissions have negative impacts on health outcomes.

RELATIONSHIP BETWEEN URBANIZATION AND HEALTH OUTCOMES

Cyril et al. [34] examined the effect of urbanization on health and found that increased urbanization is associated with deleterious health outcomes. Li et al. [35] examined the impact of urbanization on health in China and found that regions with highest urbanization level were found with a high prevalence of chronic disease in recent decades.

RELATIONSHIP BETWEEN SANITATION AND HEALTH OUTCOMES

A number of studies establish the negative effects of unsafe WASH on child health outcomes [36, 37, 38, 39]. Almond & Currie [40] points out that conditions in-utero and early in life have been found to have long-lasting consequences on individuals' health and economic outcomes. Hence, the adverse effects of WASH on maternal and newborn health must not be ignored. Gülmezoglu et al. [41] established that interventions to improve hygiene conditions during pregnancy, childbirth and in the early days of life could significantly reduce maternal and neonatal deaths. Similarly, Cameron et al. [5] found that access to at least basic household sanitation is strongly associated with substantially decreased overall risk during pregnancy and birth.

According to the aforementioned literature review, there isn't enough research on the nexus between health outcomes and health care spending, specifically a comparative study between countries based on income and regions that employs large panel data. This study fills a significant gap in the literature and has significant policy suggestions because it has a much wider scope and uses macro data from the four income groups of countries and four region-based countries.

HEALTH STATUS OUTCOMES OF INCOME GROUPS AND REGIONS

TABLE 1. MEAN DIFFERENCE OF HEALTH OUTCOMES

Panel A: Mean of IMR & LEB by Region and Income Category										
REGION	IMR					LEB				
	HIG	LIG	LMI	UMI	ALL	HIG	LIG	LMI	UMI	ALL
AFRICA	12.17	69.29	51.1 2	42.2 7	56.34	73.04	56.20	61.18	60.75	59.39
ASIA	6.558	66.62	34.8 8	20.3 4	23.39	77.78	60.58	69.04	72.06	72.20
AMERICA	9.21		23.9 8	19.0 2	17.63	78.14		70.99	73.33	74.03
EUROPE	4.27		10.6 8	9.16	5.43	78.89		69.70	72.47	77.34
ALL	5.60	69.15	41.0 0	21.3 5	28.52	78.38	56.43	65.50	70.72	69.70

Panel B: Mean Difference of IMR & LEB between Regions									
REGION	IMR				LEB				
	AFRICA	ASIA	AMERICA	EUROPE	AFRICA	ASIA	AMERICA	EUROPE	
AFRICA	0.00 (0.000)	32.95*** (30.15)	38.71*** (30.05)	50.91*** (52.1)	0.00 (0.000)	-12.80*** (-38.25)	-14.64*** (-35.3)	-17.94*** (-53.1)	
AISA			5.76*** (5.85)	17.96*** (24.4)			-1.83*** (-6.15)	-5.14*** (-20.15)	

AMERICA				12.19*** (32.5)				-3.30*** (-13.15)
EUROPE				0.00 (0.000)				0.00 (0.000)
Panel C: Mean Difference of IMR & LEB between Income Groups								
Income Group	IMR				LEB			
	HIG	LIG	LMI	UMI	HIG	LIG	LMI	UMI
HIG	0.00 (0.00)	- 63.54*** (-83.05)	-35.39*** (-45.95)	-15.75*** (-29.45)	0.00 (0.00)	21.95*** (85.95)	12.88*** (44.7)	7.66*** (32.9)
LIG			28.14*** (20.10)	47.79*** (41.75)			-9.07*** (-19.85)	-14.29*** (-37.95)
LMI				19.64*** (19.70)				-5.21*** (-14.5)
UMI				0.00 (0.00)				0.00 (0.00)

Notes: "t values are in parentheses, *** indicates significance level at 1%"

From Table 1. In Panel A, mean IMR and LEB are compared across geographic regions and income groups. First, comparing across regions, mean IMR is highest in Africa (56.34 per 1000 live births), which is over ten times higher than that in Europe (5.43 per 1000 live births). Different socioeconomic factors are considered responsible for the high rate of infant mortality in Africa. The most cited factors are low female education, lower per capita income, lack of environmental cleanliness, lack of improved sanitation, and low expenditure on health [42]. In addition, America and Asia have mean IMRs of 17.63 and 23.39, respectively. Second, a comparison of IMR across income groups reveals that the low-income group has the highest mean IMR at 69.15, while the high-income group has the lowest mean IMR at 5.61. The mean IMR for the upper-middle-income group is 21.36, while that for the lower-middle-income group is 41.00. The study also found different IMRs in different geographic regions under a particular income group. For instance, under the upper-middle income group, Africa has mean IMR of 42.27, while Europe has a mean IMR of 9.16. Therefore, the findings imply that geographic region influences IMR to a greater extent.

Further, panel A displays that the highest (77.34 years) and the lowest (59.40 years) mean LEB were reported in Europe and Africa, respectively. Further, America and Asia have mean LEBs of 74.04 and 72.20 years, respectively. A comparison of LEB across income groups showed that the high-income group has the highest LEB of 78.38 years, while the low-income group has the lowest LEB of 56.43 years. Additionally, LEB for the "upper-middle-income group" is 70.72 years, while that for the "lower-middle-income group" is 65.50 years. Hence, the difference in LEB is more across income groups than across geographic regions. Therefore, income level is a significant determinant of LEB.

The large regional differences in mean IMR and LEB are reported in panel B of Table 1. The mean IMR in Africa is 50.91 higher than the mean IMR in Europe. The mean LEB in Africa, on the other hand, is 17.94 less than the mean LEB in Europe. Furthermore, panel C of Table 1 demonstrates the significant variations in mean IMR and LEB amongst various income categories. In comparison to the low-income group, the mean IMR in the high-income group is 63.54 lower. On the other side, the mean LEB in the high-income group is 21.95 greater than the mean LEB in the low-income group. These differences in health outcomes tend to examine the effect of various health determinants on health outcomes in case of different income groups and regions of the world. These issues have clearly been addressed in the empirical section.

DATA DESCRIPTION AND METHODOLOGY

DATA

The present study employs annual data for 143 countries over 20 years (2000-2019). The countries are categorised on the basis of geographic region, and the income group (World Bank). The data are collected from the World Development Indicators Database. The countries are selected based on the availability of data for constructed variables. Detail definition of variables is given in Table 2.

TABLE 2. VARIABLES AND DEFINITIONS

Variable name	Definition
Infant mortality rate	"The number of infants dying before reaching one year of age, per 1,000 live births in a given year."
Life expectancy at birth	"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."
Total health expenditure (% of GDP)	"The sum of general government expenditure on health and private expenditure on health in a given year"
GDP per capita (constant 2015 US \$)	"GDP per capita is gross domestic product divided by midyear population."
CO ₂ emission (metric tons per capita)	"CO ₂ emissions are those stemming from the burning of fossil fuels and the manufacture of cement."
Urbanisation (% of total population)	"The percentage of total population living in urban areas as defined by national statistical offices"
Sanitation (% of total population)	"The percentage of total population using improved sanitation facilities that are not shared with other households"

Source: World Development Indicators, (World Bank 2022)

METHODOLOGY

The panel data estimation method is employed in this paper. Panel data estimate is the ideal method to use for research that involves numerous countries. Comparing panel data analysis to cross section and time series analysis, the following benefits are also present: i) panel data, which offers greater degrees of freedom and sample heterogeneity, allows for a more precise inference of model parameters, improving the efficiency and reliability of econometric results ii) the impact of omitted variables is controlled by the panel data iii) inter-individual differences are also taken into account by the panel data, and (iv) various data points can be used for various countries. Therefore, the panel data analysis for this study is justifiable.

CROSS-SECTIONAL DEPENDENCE (CSD)

As the countries are heterogeneous in nature based on their income category, so it is better to check the Cross-Sectional Dependence (CSD) among the countries. As such we use the CD test [43] to gain more clarity about that. The CSD is

calculated using the residual of the estimated ordinary least square based on the pair-wise correlation of variables. The CSD test statistics for all variables reject the null of non-existence of CSD against the alternate existence of CSD.

The literature says that panel data models are possibly to show significant cross-sectional dependency in errors due to the presence of related shocks and idiosyncratic pairwise correlation in errors without a specific pattern of similar components or positional dependence [43, 44, 45]. With the presence of CSD, the standard “Fixed Effects” (FE) and “Random Effects” (RE) models become consistent but not efficient, and the standard errors are biased [46]. So, the issues of the presence of CSD can be addressed with the application of the “Feasible Generalised Least Square” (FGLS) model. “FGLS accounts for non-constant variance and correlated error terms by estimating and incorporating the structure of the variance-covariance matrix, thereby producing more efficient and consistent parameter estimates”. The FGLS model is defined as follows:

$$IMR_{it} = \beta x'_{it} + \gamma_2 D_{2it} + \gamma_3 D_{3it} + \gamma_4 D_{4it} + \delta_i + \gamma_t + \varepsilon_{it} \dots\dots\dots (1)$$

$$LEB_{it} = \beta x'_{it} + \gamma_2 D_{2it} + \gamma_3 D_{3it} + \gamma_4 D_{4it} + \delta_i + \gamma_t + \varepsilon_{it} \dots\dots\dots (2)$$

Where IMR and LEB are the dependent variables, reflecting health outcomes of different income groups and geographic regions. X refers to the vector of independent variables that includes health expenditure, environmental factor, and socioeconomic factors. Health determinants are HE, GDPPC, CO₂ emission, URB, and SAN. D's are the dummies taking a value of 1 in the relevant regions (D_2 = Asia, D_3 = America, and D_4 = Europe), and 0 otherwise. We have taken Africa as the reference region to avoid dummy variable trap. γ_2, γ_3 and γ_4 are regional effects of being Asia, America, and Europe respectively. β and γ 's are the coefficients need to be estimated. δ_i is the cross section and γ_t is the time elements of the model and where ε_{it} is the error component. The FGLS estimator follows the succeeding moments.

$$g(\beta) = \sum_{i=1}^m z'_i \Omega^{-1} \varepsilon_i(\beta) \dots\dots\dots (3)$$

Where z'_i is considered as cross section matrix of i-th countries, $\varepsilon_i(\beta) = (y_{it} - \alpha - x'_{it}\beta)$ and Ω is a consistent estimation of the “variance-covariance matrix” Ω . The error variance in a cross-sectional analysis could differ between the groups, affecting the consistency of the estimators. The issue can be resolved with the presence of GLS, but other variability of variance might be there [47]. FGLS uses the estimated variance-covariance matrix for accurate standard errors and t-statistics and is considered as a more efficient estimator.

EMPIRICAL ANALYSIS AND DISCUSSION OF THE RESULTS

TABLE 3. IMR AND ITS DETERMINANTS

IMR	ALL	HIG	UMI	LMI	LIG
	-0.047***	-0.161***	-0.078***	-0.018*	-0.016
Inhe	(-0.006)	(-0.018)	(-0.017)	(-0.008)	(-0.00)
	-0.289***	-0.431***	-0.451***	-0.259***	-0.0967***
Ingdppc	(-0.012)	(-0.012)	(-0.029)	(-0.024)	(-0.027)
	0.006	0.094***	0.011	-0.009	-0.027**
Inco2	(-0.005)	(-0.017)	(-0.016)	(-0.008)	(-0.009)
	-1.148***	-0.299*	-0.732***	-1.305***	-0.243***
Inurb	(-0.037)	(-0.117)	(-0.081)	(-0.057)	(-0.054)
	-0.021***	-0.123***	-0.004	-0.099***	-0.355***
Insan	(-0.004)	(-0.011)	(-0.005)	(-0.015)	(-0.029)
	-0.409***	0.0397	-0.894***	-0.640***	0.125
Asia	(-0.044)	(-0.120)	(-0.109)	(-0.074)	(-0.072)

	-0.171**	0.18	-0.650***	-0.298	
America	(-0.055)	(-0.112)	(-0.098)	(-0.168)	-
	-0.799***	-0.052	-1.633***	-0.667	
Europe	(-0.061)	(-0.114)	(-0.119)	(-0.457)	-
	10.34***	7.893***	10.61***	10.94***	6.618***
Constant	(-0.121)	(-0.441)	(-0.350)	(-0.176)	(-0.206)
Obs(Country)	2860 (143)	900 (45)	740 (37)	840 (42)	380 (19)

Note: "Author's estimation. ***, **, and * indicate significance level at 1%, 5%, and 10% respectively. Standard errors are in parentheses."

Table 3 presents the impact of health determinants on IMR in overall countries and in different income groups. It also shows the impact of health determinants of different regions of the world. The results reveal that an increase in health expenditure significantly reduces IMR in high income, upper-middle income, and lower-middle income countries. However, it has no impact on IMR in low-income countries. This is true because out-of-pocket expenditure and budgetary allocations to the healthcare sector are comparatively higher in the other three income groups than in the low-income group [48, 49]. The other control variables are also found significant in the case of IMR. For example, GDP per capita remained a significant determinant of IMR for all income groups. The effect of GDP per capita is highest in the upper middle-income group, while it is lowest in low-income groups suggesting that higher per capita income results in a better standard of living which eventually improves health conditions [50, 51]. In fact, higher income enables individuals to access goods and services that improve their health. However, Anyanwu & Erhijakpor [19] discovered that variations in health outcomes in Africa were not well explained by changes in per capita income. Economic growth may not result in improved health outcomes when there is severe income inequality since preventable mortality and morbidity are typically more among the poor. Because of this, public health expenditure would counteract rising income inequality.

CO₂ emission does not demonstrate robust relationship with infant mortality since their association varies from country to country. The results in table 3 show that in high income groups, IMR increases by 0.094 per cent when CO₂ emission increases by 1 per cent. However, in low-income group, IMR reduced by 0.027 per cent when CO₂ emission increases by 1 per cent. Further, CO₂ emission is not a significant predictor of IMR in lower middle income and upper middle-income groups. The reason is that infant mortality is mainly dependent on post-natal care, hygiene and sanitation.

We also find that urbanisation is a significant predictor of IMR in overall nations and in all income groups. The findings reveal that urbanisation improves health outcomes. The reason is that urbanisation facilitates access to health services and information, quality education, safe drinking water, and better incomes which ultimately result in better health outcomes. The findings of McDade & Adair; Chinn & Fairlie; and Kohler [52, 53, 54] are consistent with our findings.

Additionally, sanitation is found to be associated with better health outcomes since there is a significant negative relationship between sanitation and IMR for three income groups except the upper middle-income group. The highest effect of sanitation on IMR is observed for the low-income group, while the smallest effect is observed for the lower middle-income group. Sanitation is crucial in health facilities as part of quality-of-care and infection prevention and control strategies, particularly to protect pregnant women and newborns from infections that could result in adverse pregnancy outcomes, sepsis, and mortality [55, 56]. Our findings are consistent with findings of Vărzaru and Rahman et al. [26, 2].

At the same time, the study also includes the regional effect on IMR for all income groups. Considering Africa as a reference geographic region, the effect of Asia, America, and Europe have been examined. The results of table 3 show a significant reduction in IMR in all the regions. Additionally, Europe has a greater potential in reducing IMR than Asia and America, particularly in the case of upper middle-income group. This is true because Europe has a policy that allows nurses or other medical staff to visit parents and infants at home. These visits combine well-baby checkups with support and caregiver advice. The findings of the results are consistent with the literature [57].

Table 4 reveals that health expenditure is positive and statistically significant for the overall countries as well as for different income groups. The result suggests that raising total health expenditure by 1 per cent will improve LEB in high income, upper middle income, lower middle income, and low-income groups by 0.016, 0.007, 0.004, and 0.009 per cent, respectively. The highest effect of total health expenditure on LEB is obtained for the high-income group, while the smallest effect is obtained for the lower middle-income group, contradicting the findings of [58].

TABLE 4. LEB AND ITS DETERMINANTS

LEB	ALL	HIG	UMI	LMI	LIG
	0.006***	0.016***	0.007***	0.004***	0.009**
Inhe	(-0.001)	(-0.002)	(-0.002)	(0.001)	(-0.003)
	0.026***	0.043***	0.034***	0.041***	0.0352***
Ingdppc	(-0.001)	(-0.002)	(-0.002)	(-0.003)	(-0.008)
	-0.003**	-0.021***	-0.006***	0.003*	0.005*
Inco2	(-0.001)	(-0.00)	(-0.002)	(-0.001)	(-0.002)
	0.190***	0.020*	0.080***	0.182***	0.117***
Inurb	(-0.006)	(-0.008)	(-0.007)	(-0.010)	(-0.016)
	0.001*	0.011***	-0.001	0.015***	0.089***
Insan	(0.000)	(-0.000)	(-0.000)	(-0.01)	(-0.009)
	0.072***	0.001	0.197***	0.106***	0.044**
Asia	(-0.006)	(-0.027)	(-0.016)	(-0.008)	(-0.015)
	0.050***	0.008	0.191***	0.055***	-
America	(-0.007)	(-0.027)	(-0.016)	(-0.008)	-
	0.058***	-0.017	0.211***	-0.021	-
Europe	(-0.008)	(-0.027)	(-0.016)	(-0.036)	-
	3.205***	3.811***	3.447***	3.108***	3.149***
Cons	(-0.019)	(-0.042)	(-0.030)	(-0.032)	(-0.063)
Obs(Country)	2860 (143)	900 (45)	740 (37)	840 (42)	380 (19)

Note: "Author's estimation. ***, **, and * indicate significance level at 1%, 5%, and 10% respectively. Standard errors are in parentheses."

Per capita income is also positive and statistically significant for the overall countries and for all income groups indicating that higher per capita income leads to higher LEB. The people with higher level of income always have tendency towards avoiding unhealthy behaviours and incurring more health expenditure. Moreover, higher income per capita ensures people to live in less polluted areas and improved houses. This is consistent with previous studies [59].

Further, urbanisation and sanitation significantly improve LEB in the overall nations as well as in all income groups. Large cities of these regions could have better access to health care, quality education, safe drinking water, and better incomes, which result in better health outcomes [52, 53, 54]. Finally, CO₂ emission has significantly reduced LEB in high-income, upper-middle-income, and overall nations. However, it has marginally improved LEB in lower-middle-income and low-income groups.

Considering Africa as a reference geographic region, the present study investigates the impact of the geographic region on LEB. The results of Table 4 show a significant improvement in LEB in all the regions. In the upper-middle-income group, all regions have significantly increased LEB, with highest improvement of LEB in Europe i.e., 0.211 in addition to Africa. In lower-middle-income group, Asia and America have increased LEB respectively by 0.106 and 0.055 from Africa. In high-income group, no region has significant impact on LEB. The changes in LEB are disproportionately determined by high per capita GDP rather than regional factors such as urbanisation, sanitation, and CO₂ emissions.

CONCLUSION AND POLICY SUGGESTIONS

This paper has examined the impact of health determinants on two health outcomes such as infant mortality rate and life expectancy at birth for groups of countries defined on the basis of the income level and geographic location. The objectives of this paper were: (1) to investigate the relationship between different health determinants and health outcomes in groups of countries with different income level and geographic regions, (2) to compare the effects of health determinants on health outcomes between income groups and geographic regions. After employing FGLS model, total health expenditure improves health outcomes by reducing infant mortality and increasing life expectancy in different income groups and geographic regions. The present research confirms the findings of previous research on the relationship between health expenditure and health outcomes [1, 2, 60]. Further, the study finds that other factors significantly contribute to the improvement of health outcomes. For instance, higher per capita income is associated with lower infant mortality and higher life expectancy at birth. Per capita income elasticities are higher than that of total health expenditure, suggesting that the impact of income level on health status is greater. In addition, urbanisation and sanitation also contribute to the reduction of infant mortality and in the increase of life expectancy at birth. However, CO₂ emission does not show consistent relationship with two health outcomes.

The present study makes the following policy recommendations in light of the aforementioned research findings. Firstly, health expenditure must rise across all countries, especially in lower and lower-middle income categories to enhance the health status of the people in these areas. Secondly, efforts should be made and the right policies must be approved to raise the per capita income and per capita health expenditure. Further, in high income and upper middle-income countries, carbon emission is relatively more due to rapid industrialisation and usage of heavy vehicles. Therefore, green technology and proper environmental policies should be executed by these countries in order to improve the health status of these countries. Next, the countries must adopt policies for the improvement of urbanisation and sanitation for the betterment of health status of the people.

The present study faced some limitations. Some important variables such as diet, lifestyle, education level, corruption and environment have not been incorporated as explanatory variables in the models. These variables might have a significant impact on the health status of the population. Future research may address these limitations.

DECLARATION OF COMPETING INTEREST:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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