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STUDY ON THE DETERMINANTS OF HEALTH OUTCOMES IN NORTHERN EUROPE AND THE BALTIC REGION[4]

The study aims to examine the potential determinants of health outcomes for the countries of Northern Europe and the Baltic region. This paper employed a one-way fixed effects model and the Arellano-Bond estimator to examine the influence of potential determinants of health outcomes using data from the World Bank Development Indicators from 1961 to 2020. The findings reveal that health expenditure as a share of GDP, physician density, tobacco consumption, and the level of per capita GDP drives up life expectancy. Similarly, physician density, hospital beds, nurses' and midwives' density, tobacco consumption, labour force participation rate, the level of per capita GDP, and the unemployment rate are significantly associated with crude mortality. Moreover, all the variables used as the potential determinants of health outcomes in the model are significantly associated with mortality from chronic non-communicable diseases. There is a need for the policymakers of these countries to consider the joint effects of these determinants when implementing policies targeted at improving health outcomes.
Keywords: Health expenditures; health outcomes; Baltic region; Northern Europe
JEL: I15; I21; E12

1. Introduction

Health outcomes have improved greatly in developed countries over the past decades. For instance, Ho and Hendi (2018) contend that life expectancy at birth is one of the key indicators of the well-being of a country, serving as a crucial proxy for the population's health by signifying the absence of diseases and a complete state of physical and mental health. It is beyond the normal figures, it is one of the approaches used to assess the effects of government interventions, the nature of human interactions, and the cultural patterns of a

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given country. Shaw, Horrace, and Vogel (2005) have pointed out that life expectancy affects the social and other economic dimensions of human life which include human capital, economic growth, labour productivity, fertility rate, and public expenditure. Likewise, one of the studies by Bloom and Canning (2000) and Schultz (2002) demonstrates that improvement in health outcomes triggers economic growth. Similarly, studies by Cervellati and Sunde (2013) and Prettner (2013) argued that improvement in health outcomes is associated with mass expansion of investments in emerging areas such as innovations and science and technology. Numerous studies, including Bhargava et al. (2001) and Cervellati and Sunde (2013) have established a positive link between economic growth and the population's health measured by improvement in health outcomes. Aísa, Clemente, and Pueyo (2014) illustrate that the global community witnessed a remarkable improvement in longevity and reduced infant mortality, and better living conditions have improved the prospects of survival among adults. This particular trend has been noticeable in OECD countries although in a non-linear fashion and differs due to country specific conditions.

Numerous studies have furnished empirical evidence of the determinants of health outcomes. For example, Adler and Newman (2002) identified that improving longevity depends on the probability of living in the younger years, the behaviours involved in the middle years, and the influence of the environment surrounding. Nixon and Ulamnn (2006) demonstrated that the level of healthcare expenditure of a country is a powerful determinant of its health outcomes. Roffia, Bucciol, and Hashlamoun (2023) evaluated that per capita GDP, out-of-pocket expenditure, physician density, and hospital beds determine longevity for the OECD countries. Studies by Mackenbach (2003) pointed out that the expansion of healthcare services particularly for the elderly and the increase in healthcare spending are associated with improvement in health outcomes. However, research by Barlow & Vissandjee (1999), Rhee (2012), and Blázquez-Fernández, Cantarero-Prieto, & Pascual-Saez (2023) suggested that healthcare spending has indirect effects on health outcomes. In particular, Rhee (2012) argued that private healthcare expenditure is more important in improving health outcomes compared to public healthcare spending. Berger and Messer (2002) demonstrated that mortality rates tend to rise when public financing dominates healthcare financing in a study of OECD countries. Grima et al. (2018) observed that the incidence of out-of-pocket healthcare expenditure has been on the rise in Europe which underscores the relevance of the private sector in improving health outcomes.

Furthermore, Basu et al. (2019) found that mortality rates are lower in counties with a higher number of registered physicians. Tjadens et al. (2013) pointed out that inequalities in the remuneration of physicians are linked to physicians' mobility leading to a shortage of physicians in their home country, and thus, causing a poor health outcome. Similarly, studies by Cochrane, St Leger and Moore (1978), Laranjeira and Szrek (2016), Nixon and Ulmann (2006), and Park and Nam (2019) underscored that alcohol and tobacco consumption are life-risk behaviours leading to the worst health outcomes. Moreover, research by Martinson (2012) revealed disparities in health outcomes based on income levels in the UK and USA. Rogot, Sorlie, and Johnson (1992) have highlighted that employment is often seen as a crucial determinant of health outcomes. Van den Heuvel and Olaroiu (2017) demonstrated that countries that spend a higher percentage of their GDP on healthcare have fewer healthcare issues and achieve better health outcomes. Brunekreef and Holgate (2002) found that reductions in CO_2 emissions and other air pollutants significantly improve public health.

Table 1 provides the summary statistics of life expectancy, crude deaths, NCDs mortality, per capita GDP, and current health expenditure as a share of GDP for the study countries. Among the study countries of NUB, available data shows that while Iceland and Sweden have the highest life expectancy, Iceland and Norway have the highest living standard. Similarly, while Germany and Iceland have the highest level of health expenditure as a share of GDP, Russia and Poland have the lowest level of health expenditure as a share of GDP among these countries. However, while Latvia, Poland and Russia have the highest burden of crude mortality, Poland and Russia have the highest burden of mortality attributed to chronic diseases. Therefore, this indicates that the countries with the highest living standard are not the countries with the highest burden of mortality in the panel.

Table 1

Country	Lyf_Exp		Crude deaths		NCDs mortality		Per capita GDP		Health expenditure (% GDP)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Denmark	4.3	0.03	2.3	0.08	3.1	0.39	10.7	0.32	1.7	0.89
Estonia	4.2	0.04	2.5	0.88	3.2	0.21	8.9	1.04	2.2	0.46
Finland	4.3	0.06	2.3	0.04	3.1	0.54	10.3	0.41	1.6	0.63
Germany	4.3	0.05	2.4	0.07	3.1	0.40	9.5	1.10	2.3	0.08
Iceland	4.4	0.04	1.9	0.05	2.9	0.52	12.5	3.27	2.3	0.18
Latvia	4.3	0.03	2.6	0.12	2.7	0.91	8.5	1.01	1.6	0.25
Lithuania	3.0	0.20	2.4	0.18	2.9	0.20	4.1	0.41	2.1	0.27
Norway	4.3	0.03	2.3	0.10	2.7	1.11	10.9	0.43	1.6	0.83
Poland	4.2	0.04	2.2	0.10	3.4	0.35	9.3	0.35	1.4	0.71
Russia	4.2	0.03	2.5	0.23	3.2	0.27	9.3	0.33	1.1	0.84
Sweden	4.4	0.04	2.3	0.07	2.7	0.3	10.5	0.31	1.8	0.75

Source: Prepared by the authors.

However, this paper analyzes the determinants of health outcomes for the countries of Northern Europe and the Baltic (NUB) region. The subsequent Section 2 outlines the methods employed in this study. Section 3 presents the results, followed by a discussion in Section 4, and the last Section 5 concludes the study.

2. Methods

Table 2 presents the list, description, and source of the data of the variables employed in this study. Three variables are selected as health outcomes in line with the extant literature. Similarly, the explanatory variables are also selected based on the literature reviewed in the introduction section. The data is collected from the World Bank (2023) from 1961 to 2020.

The summary statistics for the entire variables employed in this study are presented in Table 3. While the mean value of Lyf_Exp is 69.4 years, for the entire countries of NUB, the highest value is observed in Iceland (78.2), and the lowest value is found in Russia (67.9). The average of Crude_Mrt for the panel data is 3.5, its highest and lowest values are found in Latvia (13.0), and Iceland (6.7). The mean value of NCDs_Mrt is 2.3, and its maximum value is found in Poland (23.6), and Latvia (11.4) has the minimum value. In addition, the average value of Hexp_GDP for the entire NUB countries is 5.8, with Iceland (10.6), and Russia (2.2) having the minimum and maximum values, respectively. The average value of Hexp_OOP is 5.6, and its minimum value is found in Iceland (2.1), and the maximum value is observed in (Estonia (4.5). Similarly, the mean value of Phy_Density is 3.2, and the lowest and highest values are observed in Poland (1.9), and Finland (3.4).

Table 2. Variables, description, and source of data

Variable	Abbreviation	Description	Source
Life expectancy at birth, total	Lyf_Exp	Total number of years a person is expected to live in a country	WBDI
Crude death per 1000 population	Crude_Mrt	Is the total number that occurred during the year per 1000 population	-
Mortality rate from chronic diseases	NCDs_Mrt	Is the number of adults who died from chronic diseases during the year per 1000 population	-
Health expenditure as a share of GDP	Hexp_GDP	Is the amount of resources budgeted for the provision of healthcare every year?	-
Out-of-pocket health expenditure	Hexp_OOP	Is the direct payment incurred by households at the point of utilizing health services	-
Physician density	Phys_Density	Is the number of trained doctors who provide various types of care to the patients	-
Hospital beds density	Hspbds_Density	Is the number of hospital beds supplied to the facility for assisting physicians in providing care	-
Nurses and midwives' density	N&M_Density	Are the number of nurses and midwives who assist physicians in care provision	-
Alcohol consumption, total	Alchol_Cons	Is the prevalence of alcohol use among adults in the population of a country	-
Tobacco consumption, total	Tbc_Cons.	Is the prevalence of tobacco use among adults in the population of a country	-
Labour force participation, total	Lab_force	Is the percentage of the population that is between the age of 15-65 years	-
Per capita GDP	GDP_PC	Is the sum of the value of goods and services produced in an economy within a year?	-
CO_2 emissions per metric tons	CO_2_Emissions	Is a colorless form of air pollutant that is released from burning oil, coal, and waste materials	-
Unemployment rate	Unemp_Rate	Is the number of people who are not able to find a paid job in a given country	WBDI

Life expectancy at birth is measured in years, crude mortality is measured per 100,000 population, NCDs mortality is for adults who are between the exact ages of 30 to 70 years, health expenditure as a share of GDP is measured as a percentage of annual budget that is budgeted for healthcare, out-of-pocket health expenditure is measured in Purchasing Power Parity International USD. Physician density, hospital beds, and nurses density are measured per 1,000 population, alcohol consumption is measured in per capita litre of pure alcohol, tobacco consumption is measured as a prevalence of current tobacco use among adults, labour force participation is measured as the total number of adult within the age of 15-65 years of age, per capita GDP is measured in Purchasing Power Parity International USD, CO_2 emissions in metric tons, and the unemployment rate is measured as the number of the active labour force who are unable to find paid jobs.
WBDI means World Bank Development Indicators
Source: Compiled by the authors.

The mean value of Hspbds_Density is 2.3, and the minimum and the maximum values are observed in Finland (5.7), and Russia (11.2). The mean value of N&M_Density is 2.4, and the lowest and the highest estimates are observed in Norway (4.6), and Iceland (8.9). The average values of Alchol_Cons and Tbc_Cons are 2.1 and 3.6, and the minimum and the maximum values are observed in Latvia (3.4), Norway (5.7), and Lithuania (6.7), Russia (8.4), respectively. Moreover, the average values of lab Force and GDP_PC are 15.1 and 9.5, and the minimum and maximum values are found in Sweden (4.3), Denmark (8.5), and Estonia (3.4), Norway (8.2), respectively. The mean values of CO_2_Emissions and Unemp_Rate are 2.2 and 1.7, and the minimum and maximum values are Lithuania (2.4), Russia (5.8), and Norway (3.2), Poland (6.4), respectively. Therefore, the result shows that health outcomes and their determinants are not improving in favour of one country among the group of countries under study.

Table 3. Descriptive Statistics

Variable	N	Mean	Std. dev.	Min.	Max.	Country Min.	Country Max.
Lyf_Exp	660	69.4	16.3	12.5	83.5	Russia (67.9)	Iceland (78.2)
Crude_Mrt	660	3.5	2.2	2.1	8.6	Iceland (6.7)	Latvia (13.0)
NCDs_Mrt	660	2.3	0.2	1.8	2.9	Latvia (11.4)	Poland (32.6)
Hexp_GDP	660	5.8	5.5	1.3	8.5	Russia (2.2)	Iceland (10.6)
Hexp_OOP	660	5.6	0.9	1.4	6.9	Iceland (2.1)	Estonia (4.5)
Phys_Density	660	3.2	1.3	0.2	8.2	Poland (1.9)	Finland (3.4)
Hspbds_Density	660	2.3	0.8	0.7	4.3	Finland (5.7)	Russia (11.2)
N&M_Density	660	2.4	0.7	0,6	5.1	Norway (4.6)	Iceland (8.9)
Alchol_Cons	593	2.1	1.0	0.4	4.2	Latvia (3.4)	Norway (5.7)
Tbc_Cons	645	3.6	0.6	0.8	4.6	Lithuania (6.7)	Russia (8.4)
Lab_Force	660	15.1	1.7	11.4	18.2	Sweden (4.3)	Denmark (8.5)
GDP_PC	629	9.5	2.4	3.5	15.9	Estonia (3.4)	Norway (8.2)
CO_2_Emissions	647	2.2	0.7	1.9	4.5	Lithuania (2.4)	Russia (5.8)
Unemp_Rate	513	1.7	1.1	0.9	2.9	Norway (3.2)	Poland (6.4)

Source: Compiled by the authors.

2.1 The Model

The baseline model is written in equation 1, where the outcome variables are Lyf_Exp, Crude mortality, and NCDs mortality and the model includes the entire variables described in Table 1. Explicitly, the expression of the model contains the country and year effects given as i, and t:

$$\begin{aligned} Out_{it} = \alpha_0 + \beta_1 \text{Hexp\_GDP}_{it} + \beta_2 \text{Hexp\_OOP}_{it} + \beta_3 \text{Phys\_Density}_{it} \\ + \beta_4 \text{Hspbds\_Density}_{it} + \beta_5 \text{N\&M\_Density}_{it} + \beta_6 \text{Alchol\_Cons}_{it} \\ + \beta_7 \text{Tbc\_Cons}_{it} + \beta_8 \text{Lab\_force}_{it} + \beta_9 \text{GDP\_PC}_{it} \\ + \beta_{10} \text{C0}_2\text{\_Emissions}_{it} + \beta_{11} \text{Unemp\_Rate}_{it-1} + Y_i + C_i + \varepsilon_{it} \end{aligned} \quad (1)$$

The associated coefficients of βs are to be estimated after running the model, the error term is indicated as ϵ, Y *and* C are the year and country fixed effects variables in the model. The outcome variables – Lyf_Exp, Crude_Mrt, and NCDs_Mrt are regressed on the set of explanatory variables employed in the model. The pairwise correlation matrix of the three health outcome variables is reported in Tables A, B, & C in the appendix. It can be observed that Lyf_Exp has the strongest positive correlation with Phys_Density 0.91 followed by Hspbds_Density 0.87, and GDP_PC 0.82, respectively. Crude_Mrt and NCDs_Mrt have the strongest correlation with Alchol_Cons 0.772 followed by Tbc_Cons 0.664. Accordingly, for

Lyf_Exp, the Hausman specification tests (Chi-square: 737.6; *p*-value: 0.000) favour the selection of the fixed-effect model over the random-effect model. For Crude_Mrt, the Hausman specification tests reveal (Chi-square: 297.4; *p*-value: 0.000) which favour the selection of the fixed effects model. For NCDs_Mrt, the Hausman specification tests reveal (Chi-square: 337.4; *p*-value: 0.000) which favours the selection of the fixed effects model. Furthermore, there is no evidence of collinearity among the regressors where the VIF ranged from 1.35 to 6.5, and the mean value of VIF is 3.21 for each of the three regressions. Nevertheless, the endogeneity may exist in the model which can lead to reverse causality between the dependent variable and one or more of the independent variables. Thus, to overcome this, two alternative models are estimated for robustness checks. In the first case, the analysis considered a dynamic rather than a static fixed effect model – where the lagged values of the set of regressors are different times are introduced in the model. Therefore, the dynamic specification of the model can be written as:

$$\begin{aligned} Out_{it} = \alpha_0 &+ \beta_1 \text{Hexp\_GDP}_{it-1} + \beta_2 \text{Hexp\_OOP}_{it-1} + \beta_3 \text{Phys\_Density}_{it-1} \\ &+ \beta_4 \text{Hspbds\_Density}_{it-1} + \beta_5 \text{N\&M\_Density}_{it-1} \\ &+ \beta_6 \text{Alchol\_Cons}_{it-1} + \beta_7 \text{Tbc\_Cons}_{it-1} + \beta_8 \text{Lab\_force}_{it-1} \\ &+ \beta_9 \text{GDP\_PC}_{it-1} + \beta_{10} \text{C0}_2\text{\_Emissions}_{it-1} + \beta_{11} \text{Unemp\_Rate}_{it-1} \\ &+ Y_i + C_i + \varepsilon_{it} \end{aligned} \tag{2}$$

In the second case of the robustness checks, the Arellano-Bond estimator is performed on the model. Essentially, this estimator is applied to the FE model of Equation 1, where all the sets of regressors used as potential determinants of longevity are used as instrumental variables by considering their most recent lags (1 to 3). Generally, there is no standard rule of thumb to be followed in choosing the number of lags to be included in examining the year delay to be considered in a dynamic model. Thus, for this reason, this study considered 1 to 3 lags, the estimates are reported in columns (2), (3), and (4) of Tables 3-5. This implies that, if a health outcome is examined in year t, the set of explanatory variables is examined in the year $t - 1, t - 2, and\ t - 3$. Therefore, these two approaches are applied to the model to correct the potential problem of endogeneity in the model.

3. Results

The estimates of the static and the dynamic regression model where Lyf_Exp is used as the dependent variable are reported in Table 4. The baseline model is reported in column (1) where the behaviour of the dependent and the set of independent variables is statically observed in the same year. The value of *R*-Square of the static model is 0.53 which suggests that more than 50 percent of the variation in Lyf_Exp is fully explained by the variability of the independent variables of the model. Evidence shows that Hexp_GDP, Phy_Density, Tbc_Cons, and GDP_PC are all significant and contribute to improving Lyf_Exp. However, though significant, CO_2_Emissions is negatively associated with longevity. In addition, in columns (2), (3), and (4), the dynamic estimates of the model are reported, and the results show that Hexp_GDP is not significant in the three specifications of the dynamic model. Moreover, Lab_Force is not significant in column (2), CO_2_Emissions, in columns 3 and 4, and Unemp_Rate in column (3). The Arellano-Bond estimator is reported in column (5).

Estimates of the baseline model are almost the same as the Arellano-Bond estimator. However, Hspbds_Density and N&M_Density are significant in the baseline model but not significant in the Arellano-Bond estimator. While CO_2_Emissions is significant in the baseline model, Lab_Force is significant in the Arellano-Bond estimator. The results favour the significance of time effects in both the static and the dynamic models.

Table 4. Life Expectancy Regression Results

Model	(1) Baseline model Fixed effects	(2) 1-year lag Fixed effect	(3) 2-year lag Fixed effect	(4) 3-year lag Fixed effect	(5) Arellano-Bond Estimator
Hexp_GDP	0.02 (0.08)**	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.07 (0.03)***
Hexp_OOP	-0.04 (0.05)	-0.01 (0.04)***	-0.02 (0.04)***	-0.02 (0.04)***	0.01 (0.02)
Phys_Density	0.03 (0.08)***	0.04 (0.01)***	0.03 (0.01)***	0.03 (0.01)***	-0.14 (0.04)***
Hspbds_Density	-0.01 (0.11)	0.04 (0.01)***	0.04 (0.01)***	0.04 (0.01)***	-0.11 (0.03)***
N&M_Density	-0.02 (0.04)	-0.01 (0.05)***	-0.02 (0.01)***	-0.02 (0.07)***	0.03 (0.02)*
Alchol_Cons	0.01 (0.09)	0.03 (0.08)***	0.03 (0.01)***	0.03 (0.02)***	-0.01 (0.03)
Tbc_Cons	0.04 (0.02)**	-0.03 (0.02)**	-0.06 (0.02)***	-0.08 (0.02)***	0.17 (0.05)***
Lab_Force	-0.02 (0.04)	0.01 (0.01)	0.01 (0.01)**	0.01 (0.04)**	0.01 (0.01)*
GDP_PC	0.05 (0.01)***	0.01 (0.05)***	0.01 (0.01)***	0.01 (0.02)***	0.04 (0.05)***
CO_2_Emissions	-0.05 (0.01)***	-0.03 (0.01)*	-0.02 (0.02)	-0.02 (0.02)	0.05 (0.04)
Unemp_Rate	-0.01 (0.05)	-0.01 (0.06)***	-0.01 (0.01)	-0.04 (0.01)*	0.02 (0.01)
Constant	1.77 (1.32)	-1.47 (0.43)***	-1.73 (0.36)***	-1.85 (0.37)***	-3.04 (2.94)
Year effects	Yes	Yes	Yes	Yes	Yes
Countries	11	11	11	11	11
Observations	660	513	472	415	660
R-Square	0.529	0.553	0.613	0.654	-
F-test	31.799	34.982	44.565	53.116	-
Probability	0.0000	0.0000	0.0000	0.0000	0.0000

**** p<.01, ** p<.05, * p<.1*
Source: Compiled by the authors.

Table 5 reports the estimates of the static and dynamic model in which Crude_Mrt is used as the dependent variable in the regression. In the baseline model reported in column (1), Phy_Density, Hspbds_Density, N&M_Density, Tbc_Cons, Lab_Force, GDP_PC, and Unemp_Rate are significantly associated with crude deaths reductions in the population. Similarly, the dynamic model is estimated using equation (2) and the result is reported in column (2), (3), and (4) of Table 4. The dynamic estimates of the model are the same regarding the sign and significance of Hexp_GDP and Hspbds_Density. In addition, N&M_Density, Tbc_Cons, GDP_PC, and CO_2_Emissions are significant in columns (3) and

(4) of the dynamic model. In column (5) of Table 4, the Arellano-Bond estimator is reported for the crude death regression model. The result shows that the Arellano-Bond estimators are robust and all the coefficients are significant except the coefficient of Lab_Force in the regression.

Table 5. Crude Mortality Regression Results

Model	(1) Baseline model Fixed effects	(2) 1-year lag Fixed effect	(3) 2-year lag Fixed effect	(4) 3-year lag Fixed effect	(5) Arellano-Bond Estimator
Hexp_GDP	0.02 (0.01)	-0.02 (0.01)	-0.04 (0.02)**	-0.05 (0.02)***	0.03 (0.04)***
Hexp_OOP	-0.01 (0.01)	0.01 (0.01)	0.02 (0.01)	-0.01 (0.01)	0.03 (0.02)***
Phys_Density	-0.05 (0.02)***	-0.03 (0.02)	0.04 (0.02)	0.03 (0.02)	0.02 (0.03)***
Hspbds_Density	-0.04 (0.02)*	-0.04 (0.01)***	0.05 (0.02)***	0.05 (0.02)***	-0.02 (0.03)***
N&M_Density	-0.03 (0.01)***	0.01 (0.02)	-0.05 (0.01)***	-0.04 (0.01)***	-0.08 (0.02)***
Alchol_Cons	-0.04 (0.02)	0.12 (0.03)***	-0.01 (0.02)	-0.03 (0.02)	-0.06 (0.04)***
Tbc_Cons	0.26 (0.04)***	-0.01 (0.01)	0.07 (0.03)**	0.06 (0.03)*	0.17 (0.02)***
Lab_Force	-0.19 (0.07)***	-0.03 (0.01)***	0.01 (0.09)	0.01 (0.01)	0.01 (0.01)
GDP_PC	0.05 (0.02)**	0.04 (0.03)	-0.02 (0.01)**	-0.02 (0.01)*	-0.09 (0.01)***
CO_2_Emissions	-0.04 (0.03)	-0.02 (0.01)	0.05 (0.03)*	0.05 (0.03)*	0.05 (0.05)***
Unemp_Rate	-0.04 (0.01)***	0.02 (0.01)***	0.01 (0.01)	0.02 (0.01)	-0.03 (0.03)***
Constant	0.45 (2.54)	-1.46 (0.82)*	-1.27 (0.71)*	-1.48 (0.66)**	2.72 (0.04)***
Year effects	Yes	Yes	Yes	Yes	Yes
Countries	11	11	11	11	11
Observations	660	513	472	415	660
R-Square	0.674	0.521	0.502	0.511	-
F-test	25.603	20.830	21.058	24.140	-
Probability	0.0000	0.0000	0.0000	0.0000	0.0000

**** p<.01, ** p<.05, * p<.1*
Source: Compiled by the authors.

Table 6 reports both the static and dynamic estimates of the model in which the NCDs mortality is used as the dependent variable in the regression. Column (1) reports the baseline estimates of the fixed effects regression model and it is found that all the explanatory variables are statistically significant. However, significant Alchl_Con and GDP_PC are not associated with NCDs mortality reductions in the regressions. The dynamic estimates of the model are reported in column (2). (3), and (4) of Table 5. The results are almost the same in columns (2) and (3) regarding the statistical significance of Hexp_GDP, Hexp_OOP, Hspbds_Density, N&M_Density, Tbc_Cons, Lab_Force, GDP_PC, CO_2_Emissions, and Unemp_Rate. However, the estimates differ from the results reported in column (4), regarding the insignificance of Hexp_OOP, and the Unemp_Rate. The Arellano-Bond Estimator reported in column (5) differs from the estimates presented in the successive columns in the sense that the only insignificant explanatory variables are N&M_Density and Alchol_Cons. The year effects are significant in both the static and the dynamic models.

Table 6. NCDs Mortality Regression Results

Model	(1) Baseline Fixed effects	(2) 1-year lag Fixed effect	(3) 2-year lag Fixed effect	(4) 3-year lag Fixed effect	(5) Arellano-Bond Estimator
Hexp_GDP	-0.09 (0.04)**	-0.12 (0.04)***	-0.20 (0.05)***	-0.19 (0.05)***	-0.38 (0.01)***
Hexp_OOP	-0.14 (0.02)***	0.05 (0.02)***	0.04 (0.02)*	0.02 (0.02)	-0.06 (0.01)***
Phys_Density	-0.17 (0.04)***	0.07 (0.05)	0.11 (0.05)**	0.17 (0.06)***	0.10 (0.01)***
Hspbds_Density	-0.03 (0.06)***	0.14 (0.06)**	0.19 (0.06)***	0.20 (0.06)***	0.38 (0.01)***
N&M_Density	-0.17 (0.02)***	-0.19 (0.03)***	-0.20 (0.03)***	-0.19 (0.03)***	-0.16 (0.04)
Alchol_Cons	-0.24 (0.05)***	-0.01 (0.04)	-0.09 (0.05)**	-0.17 (0.05)***	0.01 (0.07)
Tbc_Cons	1.21 (0.08)***	0.38 (0.08)***	0.25 (0.08)***	0.17 (0.08)**	0.78 (0.01)***
Lab_Force	-0.83 (0.18)***	-0.06 (0.03)**	-0.05 (0.02)**	-0.04 (0.02)*	0.02 (0.02)***
GDP_PC	0.35 (0.07)***	-0.14 (0.03)***	-0.13 (0.03)***	-0.13 (0.03)***	0.04 (0.02)***
CO_2_Emissions	-0.40 (0.07)***	-0.28 (0.07)***	-0.23 (0.08)***	-0.18 (0.08)**	0.03 (0.08)***
Unemp_Rate	-0.12 (0.03)***	-0.11 (0.03)***	-0.07 (0.01)***	-0.05 (0.04)	0.12 (0.06)***
Constant	11.18 (2.7)***	42.6 (2.30)***	40.9 (1.95)***	40.3 (1.8)***	-0.20 (0.08)**
Year effects	Yes	Yes	Yes	Yes	Yes
Countries	11	11	11	11	11
Observations	660	513	472	415	660
R-Square	0.835	0.793	0.780	0.777	-
F-test	156.702	108.088	99.248	96.881	-
Probability	0.0000	0.0000	0.0000	0.0000	0.0000

**** p<.01, ** p<.05, * p<.1*
Source: Compiled by the authors.

4. Discussion

The determinants of health outcomes for the NUB countries throughout 1961-2020 are analyzed. Three variables – life expectancy at birth, crude mortality, and mortality rate from chronic diseases are used as health outcomes in this study. Several potential determinants of health outcomes are explored by utilizing the static and dynamic specification of a one-way fixed-effects model. In addition, the Arellano-Bond estimator is applied to address the potential problem of endogeneity in the model. The findings reveal that Hexp_GDP, Phy_Density, Tbc_Cons, and GDP_PC drives up Lyf_Exp. Similarly, Phy_Density, Hspbds_Density, N&M_Density, Tbc_Cons, Lab_Force, GDP_PC, and Unemp_Rate are significantly associated with Crude_Mrt. Moreover, all the explanatory variables employed in the model are significantly associated with NCDs_Mrt.In line with the prior research, this study corroborates the existence of a positive link between life expectancy at birth and health expenditure as documented in previous studies by Crémieux, Ouellette, and Pilon (1999), Nixon and Ulmann (2006), Park and Nam (2019), Singh, Bala, and Kumar (2022), and Roffia, Bucciol, and Hashlamoun (2023). Additionally, the existence of a negative association between health expenditure and NCDs mortality aligns with previous results by Singh, Bala, and Kumar (2022). However, it differs from the findings drawn by Rahman, Khanam, and Rahman (2018) regarding crude mortality.

The current findings reveal that though insignificant, out-of-pocket healthcare expenditure is negatively associated with longevity. Thus, this result contrasts with the findings of Grima et al. (2018) and Roffia, Bucciol, and Hashlamoun (2023), where they found a positive link between out-of-pocket payment and improvement in longevity. However, although not significant, similar to the current results is found by Moreno-Serra and Smith (2012) and Roffia, Bucciol, and Hashlamoun (2023), where adult mortality reductions are linked to out-of-pocket payment for healthcare. Similarly, physician density is found to have a positive and significant association with longevity and contributes to mortality reductions. This result is consistent with the results of previous studies by Cochrane, St Leger, and Moore (1978), Crémieux et al. (2005), Nixon and Ulmann (2006) and Roffia, Bucciol, and Hashlamoun (2023), highlighting the importance of physicians as a crucial pillar of any healthcare system.

Regarding the density of hospital beds, the current findings indicate that it is significantly associated with mortality reductions for both NCDs and crude mortality. This is similar to the results of Babazono and Hillman (1994) and Roffia, Bucciol, and Hashlamoun (2023). Moreover, the density of nurses and midwives is found to be significant and associated with a decrease in crude deaths and NCDs mortality. This finding is in consonance with the results reported by Amiri and Solankallio-Vahteri (2019), who observed that a one-percent increase in nurse density would induce mortality reduction by 0.60 – 0.80 per cent in the OECD countries.

Furthermore, focusing on alcohol consumption, this study did not find significant evidence to support its association with an increase in longevity. However, it is found to be significantly associated with NCDs mortality reductions. This is in line with the evidence of a previous study by Sohi et al. (2021), indicating that alcohol contributes to premature mortality from a global perspective. Regarding tobacco consumption, this research revealed that tobacco consumption is not associated with a decrease in longevity. This result is different from the findings of studies conducted by Crémieux, Ouellette, and Pilon (1999), Berger and Messer (2002), Crémieux et al. (2005), and Roffia, Bucciol, and Hashlamoun (2023). Similarly, while tobacco consumption is not significant, it is not associated with reductions in crude death. However, the exact opposite is the case regarding NCDs mortality with tobacco consumption. Consistent with the observation of Rogot, Sorlie, and Johnson (1992), Berger and Messer (2002) and Roffia, Bucciol, and Hashlamoun (2023), which highlighted a positive association between labour force participation rate and longevity, this study found a negative relationship between labour force participation, crude deaths, and

NCDs mortality. The higher the level of per capita GDP of a country, the higher the life expectancy, and the lower the level of all causes of mortality should be, all else constant. It is found that per capita GDP is significantly associated with an increase in longevity but not with a reduction in crude deaths and NCDs mortality, contradicting the results of Blázquez-Fernández, Cantarero-Prieto, and Pascual-Saez (2018), Swift (2011), and Roffia, Bucciol, and Hashlamoun (2023). Similarly, this study found a significant negative association between CO_2 emissions and longevity, and CO_2 emissions and NCD mortality. These results aligned with the findings from studies by Fakhri, Hassen, and Wassim (2015) specific to MENA countries. Finally, this study found a negative significant association between the unemployment rate, crude deaths, and NCDs mortality. This is consistent with the findings from studies by Gerdtham and Johannesson (2003) on the effects of unemployment on mortality.

Therefore, the current findings could inform policy decisions for the study countries. Improving the three health outcomes studied is linked to the set of health systems indicators explored. Curbing CO_2 emissions, increasing GDP per capita and the density of physicians will improve life expectancy in these countries. Particularly noteworthy is the result of NCDs mortality regressions where all the indicators are significant. This indicates that the burden of NCDs in the studied countries can be overcome by strategizing health and economic policies aligned with the study indicators. The crude death of the population is more responsive to health system resources. Thus, augmenting the physicians, hospital beds, and nurse density will be central to reducing this particular mortality burden. This study has a couple of limitations. Firstly, this paper tried to overcome the problem of endogeneity in the model which may not be excluded completely. Secondly, the variables selected for this study are influenced by the availability of data. The unavailability of data for a few variables that may affect health outcomes could also weaken the predicting power of this study. Thirdly, mortality data reported by the World Bank is not standardized death rate data. Crude measures of mortality are affected by population aging which may have specific features that have not been accounted for in this study. Finally, the absence of socio-economic analysis among the study countries constitutes a limitation to this study. Future studies should examine variation in access to care among the studied countries particularly using the Gini index as a potential determinant of health outcomes.

5. Conclusion

This research investigates the determinants of health outcomes for the countries of NUB spanning 1961 to 2020. The variables employed as the potential determinants of health outcomes range from health financing indicators, health system indicators, social indicators, and environment and habits indicators of the population. Similarly, life expectancy at birth, crude mortality, and mortality rate from chronic diseases are used as health outcomes in this study. The analysis section employed a static and dynamic specification of a one-way fixed effects regression model to estimate the results. Moreover, for robustness checks, the Arellano-Bond estimator is applied to overcome the potential problem of endogeneity in the explanatory variables considered in the model. The result shows that health expenditure as a share of GDP, physician density, tobacco consumption, and per capita GDP are significantly associated with higher life expectancy. In addition, physician density, hospital beds, nurse density, tobacco consumption, labour force, per capita GDP, and unemployment rate are significantly associated with crude mortality. Lastly, all the sets of explanatory variables are significantly associated with the mortality rate from chronic diseases. It is important to state that while the analysis preserved the baseline results for inference for the three outcome regressions, the estimates of the dynamic models have shown additional effects of out-of-pocket health expenditure, hospital beds, nursing density, alcohol consumption, labour force, and the unemployment rate for the life expectancy regression. In addition, health expenditure as a share of GDP, nursing density, alcohol consumption, and CO_2 emissions are found to be the additional significant explanatory variables for the crude death regressions. The Arellano-Bond estimators further employed for robustness checks have confirmed most of the findings of the baseline model. Overall, the current findings reveal that health financing and health systems indicators are largely linked with improved health outcomes across the panel. However, environmental and population habits indicators are linked with deterioration in health outcomes across the panel. Evidence highlights that higher financing of healthcare by the government and an increase in income per capita translates into better health outcomes across the panel. It has been found that a higher rate of CO_2 emissions is brought about by intense energy consumption, leading to heightened air pollution in the environment and raising the burden of morbidity and mortality in the population. Therefore, future studies should consider providing evidence to the literature on the best way to improve health outcomes by incorporating an environmentally friendly source of energy into the model.

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Appendix

Table A. Matrix of correlations between life expectancy at birth and the explanatory variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) loglyfex	1.00											
(1) logchexp	0.11	1.00										
(3) logoutpck	0.22	0.51	1.00									
(4) logphys	0.91	0.10	0.01	1.00								
(5) lognsptbds	0.87	-0.14	-0.39	0.72	1.00							
(6) lognurs	-0.12	0.21	0.02	0.17	0.24	1.00						
(7) logalcohol	-0.80	0.10	-0.11	0.77	0.73	0.12	1.00					
(8) logtobac	0.56	-0.39	-0.36	-0.66	-0.36	-0.29	-0.57	1.00				
(9) loglabforc	0.09	-0.10	-0.18	-0.19	0.01	-0.21	-0.05	0.25	1.00			
(10) loggdp	0.82	0.27	0.34	-0.69	-0.74	0.06	-0.67	0.23	-0.27	1.00		
(11) log CO_2	0.46	-0.16	-0.24	-0.55	-0.23	-0.04	-0.27	0.42	0.32	0.29	1.00	
(12) logunemp	-0.35	-0.25	-0.36	0.27	0.29	-0.14	0.33	0.08	0.18	-0.57	-0.21	1.00

Source: Compiled by the authors.

Table B. Matrix of correlations between crude mortality and the explanatory variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) logcrudedth	1.00											
(2) logchexp	-0.32	1.00										
(3) logoutpck	-0.32	0.51	1.00									
(4) logphys	0.23	0.10	0.01	1.00								
(5) lognsptbds	0.37	-0.14	-0.39	0.72	1.00							
(6) lognurs	-0.34	0.21	0.02	0.17	0.24	1.00						
(7) logalcohol	0.24	0.10	-0.11	0.77	0.73	0.12	1.00					
(8) logtobac	0.21	-0.40	-0.36	-0.66	-0.36	-0.30	-0.57	1.00				
(9) loglabforc	0.41	-0.10	-0.18	-0.19	0.01	-0.21	-0.05	0.25	1.00			
(10) loggdp	-0.70	0.27	0.34	-0.69	-0.74	0.06	-0.67	0.23	-0.27	1.00		
(11) log CO_2	-0.03	-0.16	-0.24	-0.55	-0.23	-0.04	-0.27	0.42	0.32	0.29	1.00	
(12) logunemp	0.44	-0.25	-0.36	0.27	0.29	-0.14	0.33	0.08	0.18	-0.57	-0.21	1.00

Source: Compiled by the authors.

Table C. Matrix of correlations between NCDs mortality and the explanatory variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) logncds	1.00											
(2) logchexp	-0.60	1.00										
(3) logoutpck	-0.64	0.51	1.00									
(4) logphys	0.07	0.10	0.01	1.00								
(5) lognsptbds	0.46	-0.14	-0.39	0.72	1.00							
(6) lognurs	-0.24	0.21	0.02	0.17	0.24	1.00						
(7) logalcohol	0.14	0.10	-0.11	0.77	0.71	0.12	1.00					
(8) logtobac	0.47	-0.39	-0.36	-0.66	-0.36	-0.30	-0.57	1.00				
(9) loglabforc	0.23	-0.10	-0.18	-0.19	0.01	-0.21	-0.05	0.25	1.00			
(10) loggdp	-0.45	0.27	0.34	-0.69	-0.74	0.06	-0.67	0.23	-0.27	1.00		
(11) log CO_2	0.15	-0.16	-0.24	-0.55	-0.23	-0.04	-0.27	0.42	0.32	0.29	1.00	
(12) logunemp	0.41	-0.25	-0.36	0.27	0.29	-0.14	0.33	0.08	0.18	-0.57	-0.21	1.00

Source: Compiled by the authors.