Nexus Between Industrialization and Greenhouse Gas Emissions: Impacts on Infant Mortality in Lower-Middle-Income Countries

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Abstract

The study examines how industrialization, income distribution, and other socio-economic factors play crucial roles in influencing mortality rates and demographic patterns. This study used a strong, balanced panel dataset and covered 37 lower-middle-income countries. The econometrics approach DOLS used, as well as two models. The study provides mixed results for both models. In model 1, morality rate is a dependent variable, while other independent variables. In the model, greenhouse gases and urbanization both have a negative and statistically significant impact on morality rates. In Model 2, urbanization and adjusted national income level have a negative impact on the total adult mortality rate. Besides, greenhouse gases and renewable energy have a positive impact on the total adult mortality rate. The study recommends deep attention to environmental protection and adopting clean energy in lower-middle-income countries to alleviate the adverse effects of greenhouse gas emissions, industrialization, and nonrenewable energy usage on human health.

Keywords: Urbanization, Industrialization, DOLS**,** Nonrenewable Energy**,** Renewable Energy.

Introduction

A clean environment and advanced health facilities are dynamic roles for human and economic growth and development. Almost every country of the globe faces various issues. Developing countries face many climate change issues, political instability, massive population and unemployment, inflation, and health issues (Zhang et al., 2022; Siddique and Kiani, 2020). Nowadays, child mortality is a worldwide issue, and its outcome is hazardous for human lives. Child mortality is stated as 'Child death under the age of five surviving.' various economic, social, and environmental factors impact adult and infant mortality rates (Qaiser et al., 2021).

Carbon dioxide, also known as greenhouse gas, is crucial for life on Earth. It helps create the greenhouse effect, along with nitrogen oxide and methane, by absorbing thermal radiation. Without these gases, the earth's temperature would drop significantly. However, the abundance of greenhouse gases is hazardous to both the ecosystem and human health. In recent times, the massive emission of GHGs has led to global warming, which poses a colossal threat to human

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health, peace, stability, food security, and more. This is because GHG emissions are formed by a variety of human activities (Letcher, 2020). Carbon emissions, like the major causes of GHG emissions and carbon dioxide, have, instead, resulted in negative externalities in the entire globe. This is because energy usage, particularly fossil fuels, has been shown to have a harmful effect on the earth's environment, poor health outcomes, and shorter life expectancy as a result of industrialization (Mesagan and Ekundayo, 2015). In South Asia, Africa, and other developing regions, rural industries employ kerosene, biomass, liquefied petroleum gas, and biogas as sources of energy for cooking, lighting, and heating, among other things. There is mounting evidence that these kinds of energy produce greenhouse gas emissions in countries and that these emissions may be harmful to human health. Greenhouse gas emissions and other dangerous pollutants are increasing in India and other emerging countries (Smith 2000).

Energy is a crucial element for the economic development of any country as it serves as the foundation for advancement in all economic sectors. However, the benefits of energy consumption vary depending on the type of energy used and its usage in different economies. Energy consumption has been rapidly increasing worldwide due to its necessity for industrialization, power production, and the operation of other sectors of the economy. Different countries around the world use various types of energy resources (Fang et al., 2022). Developed countries generally use clean energy, which is environmentally friendly and produces little air pollution, thus not impairing human health (Manisalidis et al., 2020). However, developing countries prefer cheap energy, also known as nonrenewable energy, which is inexpensive but detrimental to health and the environment. Global energy demand is expanding due to its importance, and most advanced countries accept renewable energy due to its environmental benefits. Developing countries will also need to adopt it, even though the production of renewable energy resources is lower than that of nonrenewable resources. Clean energy comes from endless sources such as water, wind, and sun, but its output still needs to be higher in the United States, with only 10% of energy coming from renewable sources. Coal, oil, and natural gas are the primary sources of nonrenewable energy globally (Yu et al., 2023; Zhang et al., 2023; Shang et al., 2022).

The study conducted by Azam et al. (2016) and Aye et al. (2017) used the Dynamic Panel Threshold Model to measure the impact of economic growth on CO2 emissions in emerging economies. The research revealed that promoting high growth rates in economies has resulted in a decline in environmental quality. This could have negative consequences on public health in the short term, but it may be sustainable in the long run. Furthermore, the usage of different energy types has varying effects on human health. Renewable energy is a safer option as it has no negative health effects and does not increase the mortality rate in Sub-Saharan Africa. However, in rural areas of the host country, industrial production and the use of coal energy have generated health issues and increased mortality rates (Ibrahim et al., 2021). Developing countries have been facing several challenges, such as slow economic growth, a significant gap between energy supply and demand, a high mortality rate, and an increase in respiratory diseases due to poor environmental quality. To meet the growing domestic energy demand, industries have increased their usage of fossil fuels like oil, coal, and gas, while households have started using solid fuels more commonly. Although using these fossil fuels can increase per capita income, it also leads to the production of greenhouse gases that are harmful to human health. The consumption of such fuels and pollution are directly related to health problems in developing countries, which paints a bleak picture of environmental disorder. This demonstrates the cost of economic gain in terms of bad health for people and other living beings. It's not surprising that energy is a crucial component of our lives, and it also helps to boost the production of other goods and services. (Green et al., 2013; Mikhaylov et al., 2020). Industrialization is crucial for economic growth, and energy is just as vital as gasoline for powering cars and other fuel-consuming machinery. Therefore, energy consumption is essential for every country's development, as it serves as the foundation for all economic progress. However, due to differences in energy use and types of energy used in different countries, the benefits of using energy in diverse economies may vary. Most industrialized and well-developed countries use benign energy sources, such as renewable energy sources, to produce energy, unlike emerging and poor countries, which use cheaper and nonrenewable energy sources, resulting in very little air pollution (Alahmad et al., 2023; Mawusi et al., 2023).

Industrialization is crucial for economic prosperity, and energy is just as significant as gasoline in powering cars and other machinery that consumes fuel. Therefore, energy consumption is vital for every country's development as it is the cornerstone of all economic progress. However, differences in energy use and the types of energy used in various countries may result in varying benefits of using energy in different economies. Most industrialized and well-developed countries use benign energy sources, such as renewable energy, to produce energy, in contrast to emerging and poor countries that use cheaper and nonrenewable energy sources, resulting in very little air pollution (Sumaira & Siddique, 2023; Raihan, 2023; Chikezie et al., 2023). Lower Middle-Income Countries are developing nations experiencing many economic and environmental issues that impact human health. The study aims to determine the impact of environmental degradation caused by greenhouse gas emissions, industrialization, urbanization, and the use of both types of energy on infant and adult mortality rates. Child and adult mortality are global issues, but this study focuses on lower-middle-income countries. The primary objective of the research was to establish the effects of greenhouse gases and industrialization on human health (Chen et al., 2023; Mor & Ravindra, 2023; Luo et al., 2023).

Renewable energy sources, such as hydro, photovoltaic, and nuclear, are making the fastest progress despite being less frequently used compared to nonrenewable sources. The usage of renewable energy is increasing at a pace of 2.5% annually. As the world's population grows, the energy demand also increases. Developed nations are shifting towards renewable energy, which is more environmentally friendly and produces less pollution (Al-Afif et al., 2023; Hassan et al., 2023; Raihan et al., 2023). Developing countries are increasingly shifting from nonrenewable energy sources to renewable ones. Fossil fuels, such as rubbish, timber, and agricultural waste, are commonly used in rural, lower-middle-income countries due to the lack of appropriate energy sources for cooking, cleaning, heating, and other household chores. Women and children spend a lot of time in the kitchen, where the use of fossil fuels can have severe and adverse effects on their health, making them more vulnerable to illness and increasing mortality rates. It is important to transition to renewable energy sources to reduce these harmful impacts and promote a healthier living environment for all (Mmereki et al., 2023; Rani et al., 2023). The study found that greenhouse gas emissions, industrialization, and nonrenewable energy consumption had a significant impact on mortality rates for both newborns and adults. The main environmental issues in Lower Middle-Income Countries are greenhouse gas emissions, smoke, and other pollutants caused by industrialization and nonrenewable energy sources. These factors have harmed human health and increased mortality rates. Therefore, it is essential to focus on environmental cleaning measures and the use of clean energy to improve human health. Pakistan has the highest child mortality rate among lower-middle countries (Sheikh et al., 2023).

Objectives of the Study
The basic objective of this study is to examine the consequences of industrialization on human health, urbanization, the emission of GHG, both sorts of energy uses, and the income level of particular South Asian countries. There are numerous objectives for this goal, such as:

- To investigate the impact of the emission of GHG, mortality and infant mortality rate, nonrenewable energy consumption, and indoctrination in selected Lower-Middle-Income Countries.
- To study the effect of renewable and nonrenewable energy on child mortality rates.
- To explain the direct impact of renewable energy consumption, urbanization, and level of income on human health.

Literature Review

Adeleye et al. (2023) investigated the third goal of the 2030 United Nations Sustainable Development Goals. The study focused on the relationship between nonrenewable energy, carbon emissions, and infant mortality rate. It analyzed data from 42 Asia-Pacific countries between 2005 and 2015 using structural equation modeling (SEM). The study revealed that nonrenewable energy indirectly affects infant mortality rate through carbon emissions. It also found that carbon emissions have a direct effect on infant mortality rate. Furthermore, the study indicated that the mediation effects of carbon emissions vary across income groups, such as lower-middle and upper-middle-income countries.

Siddique and Kiani (2020) explored the relationship between industrial pollution and health in developing countries. Despite the economic growth observed in these economies due to industrialization, they have also experienced a rapid increase in pollution. The study used a panel from 1990 to 2016 and covered middle-income countries. The econometrics approach of fixed effects was used to analyze the data. The study found that industrial pollution is associated with a decrease in life expectancy and an increase in infant mortality. Moreover, the negative impact is more pronounced in lower-middle-income countries compared to upper-middle-income countries. The study recommended implementing programs to improve human health by emphasizing policies that aim to reduce the burden of industrial pollution.

Anser et al. (2020) examined the impact of economic activities, GHG emissions, and energy utilization on health risks such as mortality rate and respiratory diseases in developing Asian nations. The study observed the short-term and long-term effects of environmental pollution and diseases on health problems. The empirical study found that GHG emissions, depletion of natural resources, and fossil fuel consumption are the primary contributing factors to growing health risks in the long run. However, the use of clean energy and increasing per capita economic growth help improve the health status of families. In the short term, GHG emissions are the leading cause of the high mortality rate in emerging Asian economies. The study recommends government intervention measures to save the region from the harmful consequences of environmental pollution and nonrenewable energy use. In emerging Asian countries, the use of fossil fuels, pollution, and the lack of access to clean energy contribute to high mortality rates and an increase in the prevalence of respiratory diseases. The study suggested that alternative green energy, which controls GHG emissions and improves environmental quality, can help control various health diseases.

Brueckner (2019) examined urbanization and adult mortality and weak correlation in sub-Saharan African countries. The panel approaches, and panel data set were used from 1960 to 2013. The study examined no significant negative association between urbanization and adult mortality in

sub-Saharan Africa. In the entire world, the association between urbanization and adult morality is highly significantly negative. The lack of a substantial negative association between adult mortality and urbanization in Sub-Saharan Africa is large due to the high prevalence of HIV. Adult mortality and urbanization were highly adversely associated in Sub-Saharan Africa during the 1960s and 1970s, before the HIV epidemic. According to panel model estimates, the urban health premium is falling in HIV prevalence. Despite various characteristics in sub-Saharan Africa, urban health has increased. Besides, people still face health problems most ia and high average temperatures. The high HIV prevalence rates in the 1990s and 2000s completely overshadowed these characteristics, resulting in an average. In Sub-Saharan Africa, there is no significant negative correlation between urbanization and adult mortality.
Sulaiman et al. (2017) examined that the impact of wood fuel consumption on health in sub-Saharan Africa was analyzed. The study focused on mortality rates among adults and children under the age of five between the years 2005-2013 and used the GMM approach. The study found that an increase in wood fuel consumption had a positive impact on adult mortality rates, with a higher effect on male adults than female adults. Moreover, the study also found that mortality rates from wood smoke-related infections were higher amongst children under the age of five than in adults, with a higher impact on female adults than male adults. As a result, the study recommended the provision of an alternative, affordable, and clean energy source for cooking and heating to reduce the use of wood fuel.
Researchers have conducted numerous studies to investigate the correlation between infant mortality rate and greenhouse gases. Additionally, there have been a few studies that aimed to find the association between infant mortality rate, urbanization, industrialization, and national income. This research is a significant contribution to the literature review.

Data and Methodology

Data is the primary and fundamental tool for analyzing any econometrics approach. Valid and deterministic sources are to be adopted for data collection. Afterwards, the data collection is the variable description and approach for the analysis. For this analysis, we adopted a panel dataset. The data are taken from the World Development Indicators (WDI). The current data is associated with lower-middle-income countries. There are 54 countries in the WDI database, and this study observed 37 of them. In this study, we used two models. Model 1 contains a total of six variables. $IMORT_{it}$ is a dependent variable, while $LGHGE_{it}$, IND_{it}, URB_{it}, LNONREit, and LRE_{it} are independent variables. Model 2 contains five variables. $ADULT_{it}$ is a dependent variable, while $LGHGE_{it}$, URB_{it}, $ANNI_{it}$, and LREit are independent variables.

Mathematical and Econometric Model

Mathematical model-1

Infant mortality rate = f (Greenhouse gas, Industrialization, Urbanization, Ron-renewable energy, Renewable energy)

Or

Infant mortality rate = β_0 + β_1Greenhouse gas + β_2 Industrialization + β_3 Urbanization + β_4 Non-renewable energy + β_5 Renewable energy

Econometric model-1

$$IMORT_{it} = \beta0+\beta_1 LGHGE_{it} +\beta_2 IND_{it} +\beta_3 URB_{it} +\beta_4 LNONRE_{it} +\beta_5 LRE_{it} +\varepsilon_{it}$$

Mathematical model-2

Total adult mortality rate = f (Greenhouse gas, Urbanization, Adjusted national income level, Renewable energy)

Or

Total adult mortality rate = $\beta_0 + \beta_1$Greenhouse gas + β_2 Urbanization + β_3 Adjusted national income level + β_4 Renewable energy

Econometric model-2

$ADULT_{it} = \beta0 + \beta_1 LGHGE_{it} + \beta_2 URB_{it} + \beta_3 ANNI_{it} + \beta_4 LRE_{it} + \varepsilon_{it}$

IMORT = Infant mortality rate

LGHGE = Log greenhouse gas

URB = Urbanization

IND = Industrialization

LRE = Log renewable energy

LNONRE = Log non-renewable energy

ADULT = Total adult mortality rate

ANNI = Adjusted national income level

μ = error term i = countries t = time period

Descriptive Statistics

It describes the overall specification of the model. It is a set of techniques used to summarize, organize, and describe the main features of a dataset. Such as the mean, which indicates the sum of all values divided by the number of observations (Gul & Khan, 2021). The median indicates the middle value of the dataset. Mode refers to the most frequently used value. In dispersion, the standard deviation plays a significant role. It provides a measure of the average distance of each data point from the mean. Thus, descriptive statistics are fundamental for exploring and summarizing data before more advanced analyses are conducted. Therefore, correlation is a statistical measure that quantifies the extent to which two variables change together. In other words, it measures the degree of linear relationship between two continuous variables. The correlation coefficient is a numerical value that ranges from -1 to 1, indicating the strength and direction of the relationship (Gul et al., 2023; Reman et al., 2023).

Data Stationarity Test

Stationary is a key concept in time series analysis, serving as an essential precondition before conducting any estimations. In the milieu of time series data, stationarity is necessary to confirm reliable and meaningful statistical analyses. In panel data before some approach, we check stationary. As before, at DOLS, we check the stationary of the variable. Economists developed a variety of unit root tests, including time series, to accomplish this. This analysis is decisive for understanding the long-term behaviour of variables in a panel dataset. Two widely used panel unit root tests are the Levin-Lin-Chu (LLC) Test (Levin et al., 2002).

LLC Test

The Levin-Lin & Chu test, introduced by Andrew Levin and Chien-Fu Lin in 1992 and expanded with the contribution of Chia-Shang James Chu in 2002, is a methodology building upon the Dickey-Fuller unit root test. This test is designed to assess the stationarity of data and involves two steps. The first step, allows for variation and lag coefficients of the dependent variable across different units, while the second step introduces unit-specific time trends. The LLC approach is particularly valuable for examining divergence and lag coefficients within multiple units. The LLC test equation for the Augmented Dickey-Fuller (ADF) test statistic is expressed as:

$\Delta yit = \delta y_i, t{-}1 + \sum aiL\ p{-}1\ L{=}1\ \Delta y_i, t{-}1 + \vartheta midmt + \varepsilon_{it},$

where various coefficients and terms are involved, such as individual fixed effects (ai), the coefficient of the time trend (β), the coefficient of the lagged dependent variable (γ), the coefficient on lagged differences (δ_j), the number of lagged differences (p), error term (ε_{it}), and vectors of deterministic variables (dmt) and coefficients for different models (ϑmi). This test is instrumental in evaluating the stationarity of time series data by considering individual-specific effects and time trends (Khan et al., 2023).

Cointegration and Pedroni Cointegration Test

Cointegration is a statistical concept representing a stable, long-term equilibrium relationship between non-stationary time series variables. When multiple variables are cointegrated, it signifies that despite each variable's absent stationarity individually, a linear combination of these variables results in a stationary outcome. Panel cointegration tests, such as the Pedroni test, Kao test, or Westerlund test, analyse the collective behaviour of variables across entities and periods (Neal, 2014; Udemba et al., 2023). These tests determine whether a linear combination of variables is cointegrated across the entire panel, indicating a shared equilibrium relationship among entities. The Pedroni Cointegration Test is a statistical method planned for measuring cointegration in panel data, considering cross-sectional dependence and heterogeneity among entities. It is an extension of the traditional Engle-Granger co-integration test to accommodate panel data characteristics. The fundamental equation of this test is expressed as:

$\Delta y_{it} = a_i + \beta_{it} + \sum \delta ij\rho_j{=}1\Delta\gamma y_{it} + \sum \gamma ij\rho\ k{=}0\ \Delta\gamma y_i, t{-}k + \varepsilon_{it}$

Here, Δy_{it} represents the variable of interest for entity i at time t, ai is the individual fixed effect, β_{it} is the coefficient of the time trend, and $\Delta\gamma y_{it}$ signifies the 1st difference of the variable yit for entity i at time t. The test combines coefficients for the 1st difference of y_{it} and the lagged 1st difference of y_{it} for entity i and lag k, where p and q denote the number of lags for 1st differences and lagged first differences, respectively. Pedroni's co-integration test, introduced in 1999, explains the long-term relationships based on stationarity and unit root test outcomes. Pedroni formulates seven cointegration tests, categorized into panel-v and panel rho-statistic groups, with some tests falling within these dimensions, while others spread elsewhere (Lu, 2017; Elfaki et al., 2022).

Dynamic Ordinary Least Squares (DOLS)

DOLS is an econometric technique used to estimate a model in the presence of serial correlation and endogeneity. It is particularly useful when dealing with time series data. The DOLS method extends the Ordinary Least Squares (OLS) by incorporating lags of variables and allowing for dynamic relationships. The DOLS equation for a general model with one dependent variable (Y) and several explanatory variables (X1, X2, ..., Xn) can be expressed as follows:

$Yit = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \ldots \beta_n X_{n,it} + \varepsilon_{it}$

After modifying and including lagged the variables in DOLS:

$\Delta y_{it} = a_0 + \sum_{j=1p} \alpha_j \Delta Y_{it} + \sum k{=}1_q\ \beta_k \Delta X_{k,it-k} + U_{it}$

Y_{it} is the dependent variable at time t, $X_{1,it} + X_{2,it} + \ldots X_{n,it}$ is the explanatory variables at time t, ε_{it} indicates error term. Therefore, Δ denotes the first difference operator, and a_0 is the constant term. a_j and β_k are estimated coefficients. P and q are the numbers of lagged of the dependent and independent variables and u_{it} is the residual term. The purpose of DOLS is to address potential endogeneity issues and improve the estimation of coefficients in the presence of autocorrelation. The inclusion of lagged differences helps capture the dynamic relationships between variables over time. The coefficients a_j and β_k are estimated through the DOLS procedure, which involves instrumental variable techniques to handle endogeneity concerns (Raihan, 2023; Madaleno and Moutinho, 2021).

Results and Discussions

Table 1: Descriptive statistics for models 1 & 2						
Model-1: $IMORT_{it} = \beta0+\beta1LGHGE_{it} +\beta2IND_{it} +\beta3URB_{it} +\beta4LNONRE_{it} +\beta5LRE_{it} +\varepsilon_{it}$						
	$IMORT_{it}$	$LGHGE_{it}$	IND_{it}	URB_{it}	$NONRE_{it}$	$LREN_{it}$
Mean	36.19604	6.393910	11.03673	28.15319	29.28733	58.46963
Median	32.00000	6.308508	10.65801	26.13512	27.59822	57.24523
Maximum	110.5000	8.331648	15.04984	66.17917	70.20619	152.7694
Minimum	5.600000	5.061899	8.828156	-1.120902	5.486150	6.736325
Std. Dev.	20.95526	0.577785	1.308737	9.647869	13.88637	30.44342
Model-2: $ADULT_{it} = \beta0+\beta1LGHGE_{it} +\beta2URB_{it} +\beta3\ ANNI_{it} +\beta4LRE_{it} +\varepsilon_{it}$						
	$ADULT_{it}$	$LGHGE_{it}$	URB_{it}	$ANNI_{it}$	LRE_{it}	
Mean	7.636298	11.03229	29.34773	1737.614	6.393910	
Median	6.981000	10.65556	27.68896	1327.888	6.308508	
Maximum	21.10000	15.04984	70.20619	7375.328	8.331648	
Minimum	2.975000	8.828156	5.486150	19.12872	5.061899	
Std. Dev.	2.935537	1.309545	13.88223	1224.909	0.577785	

Table 1 describes the outcomes of the descriptive statistics for both models (Models 1 and 2). First, discuss model 1. The IMORTit value is 36.19, while the standard deviation of the same variable is 20.9. The URBit value is 28.15, while the INDit value is 11.03 in the same model. The mean values of LGHGEit and NONREit are 6.39 and 29.28, respectively. Besides, LRENit holds the highest mean value in model 1. In the same model, the lowest standard deviation is LGHGEit, while the highest is LRENit. A low standard deviation of any variable shows low variation. Therefore, the mean value of $ADULT_{it}$ is 7.63, while $LGHGE_{it}$ is 11.03 in model 2. The URB_{it} means value is less than LRE_{it} (29.34<6.39). The $ANNI_{it}$ mean value is highest in both models.

Table 2: Correlation for models 1 & 2					
Model-1: $IMORT_{it} = \beta0+\beta1LGHGE_{it} +\beta2IND_{it} +\beta3URB_{it} +\beta4LNONRE_{it} +\beta5LRE_{it} +\varepsilon_{it}$					
	$LGHGE_{it}$	IND_{it}	URB_{it}	$NONRE_{it}$	LRE_{it}
$LGHGE_{it}$	1				
IND_{it}	0.211337	1			
URB_{it}	-0.512137	0.137516	1		
$NONRE_{it}$	0.344968	0.182259	-0.124357	1	
LRE_{it}	0.365497	0.176249	-0.183237	0.499717	1
Model-2: $ADULT_{it} = \beta0+\beta1LGHGE_{it} +\beta2URB_{it} +\beta3\ ANNI_{it} +\beta4LRE_{it} +\varepsilon_{it}$					
	$LGHGE_{it}$	URB_{it}	$ANNI_{it}$	LRE_{it}	
$LGHGE_{it}$	1				

URB_{it}	-0.512137	1		
$ANNI_{it}$	0.212594	-0.135329	1	
LRE_{it}	0.365497	-0.183237	0.555369	1

Table 2 shows the results of the correlation among the projected variables. The negative sign displays a negative association between the variables, while the positive sign indicates a direct association between two specific variables. For example, there is a positive association between $LGHGE_{it}$ and IND_{it}. Similarly, $LGHGE_{it}$ is negatively associated with URB_{it}. The $LGHGE_{it}$ is also directly related to $NONRE_{it}$ and $LREN_{it}$. Therefore, IND_{it} is positively associated with URB_{it}, $NONRE_{it}$, and $LREN_{it}$. The LRE_{it} and $NONRE_{it}$ were also positively correlated with each other. In model 2, $LGHGE_{it}$ is positively correlated with $ANNI_{it}$ and LRE_{it}. Besides, URB_{it} was negatively correlated with both $ANNI_{it}$ and LRE_{it}. Therefore, $ANNI_{it}$ and LRE_{it} are also directly correlated with each other.

Table 3: Panel unit root test

LLC-Unit Root Test									
Variable	II				IIT				lags
	L		1st diff		L		1st diff		
	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.	
$IMORT_{it}$	-1.389	0.082	-3.907	0.000	-8.929	0.000	-2.681	0.003	2
$LGHGE_{it}$	-2.949	0.001	-3.071	0.001	6.687	1.000	-3.071	0.001	1
IND_{it}	-1.183	0.118	-9.831	0.000	-1.402	0.080	-9.004	0.000	1
URB_{it}	-9.172	0.000	-3.949	0.000	1.180	0.881	0.598	0.72	2
$LNONRE_{it}$	-6.223	0.000	-14.52	0.000	-24.93	0.000	-20.78	0.000	3
LRE_{it}	-2.668	0.003	-10.84	0.000	-18.69	0.000	-16.42	0.000	1
$ADULT_{it}$	-3.531	0.000	12.43	1.000	5.455	1.000	1.600	0.945	2
$ANNI_{it}$	-1.782	0.0373	-0.561	0.287	-9.088	0.000	-9.309	0.000	1

Table 3 shows the results of the LLC (Levin, Lin, and Chu) unit root tests for each projected variable. The test judges whether the variables are integrated of order 1 (have unit roots or not). The prob. value of the $IMORT_{it}$ is 0.082, which is above 5% but less than 10%. So, the $IMORT_{it}$ is significant at 10% instead of 5%. However, after taking the first difference, the test statistic becomes -3.907 and the probability value is 0.0000, which is less than 0.05. Similarly, in intercept and trend, the probability values of the same variable at the level and first difference are 0.000 and 0.003, respectively, indicating the variable is significant at the level and first difference. The variables $LGHGE_{it}$, URB_{it}, $LNONRE_{it}$, LRE_{it}, $ADULT_{it}$, and $ANNI_{it}$ are stationary at a level in Intercept. While IND_{it} is stationary after taking the first difference, Now, to summarize, all variables are stationary at level except INDit, which is stationary at first.

Table 4: Pedroni integration test

Model-1: $IMORT_{it} = \beta0+\beta1LGHGE_{it} +\beta2IND_{it} +\beta3URB_{it} +\beta4LNONRE_{it} +\beta5LRE_{it} +\varepsilon_{it}$		
Tests	**II**	**II & IT**
P-v-S	-4.989404 (0.0000)	4.509296 (1.0000)
P-rho-S	-1.732279(0.0416)	-6.172307(0.0000)
P-PP-S	-4.135849(0.0000)	-0.058550(0.4767)
P-ADF-S	-3.421868(0.0003)	-1.850291(0.0000)

G-rho-S	6.602284(1.0000)	-6.629538(0.0321)
G-PP-S	-6.129188 (0.0000)	-5.432594(0.0000)
G-ADF-S	-3.766221(0.0001)	-1.858582(0.0315)
Model 2: $ADULT_{it} = \beta 0+\beta 1LGHGE_{it} +\beta 2URB_{it} +\beta 3\ ANNI_{it} +\beta 4LRE_{it} +\varepsilon_{it}$		
P-v-S	-3.809085(0.0001)	3.184889 (0.9993)
P-rho-S	-1.996577 (0.0229)	-4.598566(0.0000)
P-PP-S	-3.495426 (0.0002)	-1.194743 (0.1161)
P-ADF-S	-2.693360 (0.0035)	-7.135458(0.0000)
G-rho-S	-1.584099 (0.0566)	-5.510907(0.0000)
G-PP-S	-2.664987 (0.0038)	-3.790641 (0.0001)
G-ADF-S	1.589404 (0.9440)	-3.864958(0.0001)
In this table, P, G and S indicate panel, group and statistic. Therefore, II and IT show individual intercepts and trends respectively.		

Table 4 shows the outcomes of the Padroni cointegration test for two different models. The test calculates the stationarity properties of the specified models. The statistics are presented for different versions of the test, namely P-v-S, P-rho-S, P-PP-S, P-ADF-S, G-rho-S, G-PP-S, and G-ADF-S. To conclude, in both models, cointegration exists among the projected variables.

Table 5: DOLS' results for Model-1 & 2

Model-1: $IMORT_{it} = \beta 0+\beta 1LGHGE_{it} +\beta 2IND_{it} +\beta 3URB_{it} +\beta 4LNONRE_{it} +\beta 5LRE_{it} +\varepsilon_{it}$				
Variables	Coefficient	Standard Error	t-statistics	Prob.
$LGHGE_{it}$	-0.444396	0.106850	-4.159086	0.0002
IND_{it}	0.032084	0.790724	0.040575	0.9692
URB_{it}	-0.140720	0.039391	-3.572415	0.0160
$LNONRE_{it}$	-0.501650	0.389336	-1.288476	0.1980
LRE_{it}	0.317634	0.237598	1.336855	0.1910
R^2	0.345326	Mean ($IMORT_{it}$)		7.569989
$\bar{R}^2$	0.335938	S.D ($IMORTi_t$)		2.871369
S. E. of Regression	0.087611	RSS		8.913992
F-statistics (Prob.)	18.23 (0.0000)	D. W. Statistic		0.552192
Model-2: $ADULT_{it} = \beta 0+\beta 1LGHGE_{it} +\beta 2URB_{it} +\beta 3\ ANNI_{it} +\beta 4LRE_{it} +\varepsilon_{it}$				
$LGHGE_{it}$	0.083593	0.039727	2.104159	0.0357
URB_{it}	-0.000237	0.000126	-1.877766	0.0609
$ANNI_{it}$	-0.000537	0.000239	-2.249109	0.0248
LRE_{it}	0.059147	0.031277	1.891061	0.0591
R^2	0.476235	Mean ($ADULT_{it}$)		7.625610
$\bar{R}$	0.471226	S.D ($ADULTi_t$)		2.934369
S. E. of Regression	2.133781	RSS		33.32811
F-statistics (Prob.)	95.0817(0.000)	D. W. Statistic		0.077338

Table 5 describes the outcome of the DOLS analysis for both models. In model 1, $IMORT_{it}$ is a dependent variable, while others are independent variables. The coefficient for $LGHGE_{it}$ is -0.4444 and the probability value is 0.0004. It indicates that a one-unit increase in $LGHGE_{it}$ would result in a 44% decrease in $IMORT_{it}$. Safdar et al., (2022) also found the same results for South Asian

Countries. Most South Asian countries are part of the lower middle-income countries. Therefore, the coefficient for IND_{it} is 0.0321 with a t-statistic of 0.0406. when the t-statistics value is less than 1.96 (5%) and 1.64 (10%), which means the variable is insignificant. In other words, an independent variable does not have a significant effect on the dependent variables. In the same case, IND_{it} is not statistically significant because the p-value is 0.9692, indicating that the effect of IND_{it} on $IMORT_{it}$ is not statistically significant. Therefore, the URB_{it} coefficient value is -0.1407 and the p-value is 0.0160, which is less than 0.05. It indicates that our dependent variables are affected by our independent variables. One unit increases URB_{it}, thus -0.1407 units decrease our dependent variable ($IMORT_{it}$). Tripathi and Maiti (2023), and Azuh et al., (2020) also supported the current results. Because, in terms of the effect of urbanization, there is no colossal difference between advanced and developing economies. Because, in both economies, urbanization declines the infant mortality rate. Urbanization brings advanced education, technology, and research and development. The coefficients for $LNONRE_{it}$ and LRE_{it} are -0.5017 and 0.317634 and a t-statistic of -1.2885 and 1.336855, respectively. When the t-statistics value is less than 1.96 or 1.64, then our p-value is less than 0.05 (5%) or 0.10 (10%), respectively. This indicates that our independent variables $LNONRE_{it}$ and LRE_{it} have no significant impact on our dependent variable $IMORT_{it}$. Besides, other statistical measures include an R-squared (R2) of 0.3453, which indicates the proportion of variability in $IMORT_{it}$ explained by the model. The F-statistic of 18.23 is significant (prob. = 0.0000), supporting the overall significance of the model. The Durbin-Watson (D.W.) statistic is 0.5522, suggesting the potential presence of autocorrelation. To summarize the analysis of the first model, the statistically significant coefficients for $LGHGE_{it}$ and URB_{it} suggest that these variables have a significant impact on $IMORT_{it}$ in Model 1, while the coefficients for IND_{it}, $LNONRE_{it}$, and LRE_{it} are not statistically significant in explaining the variation in $IMORT_{it}$. Now interpret the results of model 2 in the same table. In model 2, our dependent variable is $ADULT_{it}$. The coefficient of $LGHGE_{it}$ is 0.0836, and the t-statistic is 2.1042. The t-statistics values are greater than 1.96 (most studies indicated the t-statistics value is 2), which shows our p-value is less than 0.05 or statistically significant. A one-unit increase in $LGHGE_{it}$ is now associated with a statistically significant increase of 0.0836 per cent in $ADULT_{it}$. Therefore, the coefficient value of URB_{it} is -0.0002, and the probability is 0.0609, which is slightly higher than the conventional significance level of 0.05 but statistically significant at 10%. Besides, our independent variables statistically and significantly impact our dependent variable, $ADULT_{it}$. One unit increases the URB_{it}; thus, -0.0002 units decline our $ADULT_{it}$. National income is also playing a significant role in the overall activities of nations. It is the backbone of any economy. Most developing economies are facing economic crises due to low GDP (national income) (Akhtar et al., 2020). The coefficient value of $ANNI_{it}$ is -0.0005 and the t-statistic is -2.2491, while the p-value is 0.0248. A one-unit increase in $ANNI_{it}$ is associated with a statistically significant decrease of 0.0005 units in $ADULT_{it}$. Similarly, the coefficient value of LRE_{it} is 0.0591, and the p-value is 0.0591. It indicates that our independent variable significantly impacts our dependent variable. Our all-model is best or not. For this purpose, we check other statistical measures, including an R-squared (R2) of 0.4762, indicating the proportion of variability in $ADULT_{it}$ explained by the model. The F-statistic of 95.0817 is highly significant (prob. = 0.000), supporting the overall significance of the model. The Durbin-Watson statistic is 0.0773, suggesting the potential presence of autocorrelation (Gul et al., 2023). In summary, the statistically significant coefficients for $LGHGE_{it}$ and $ANNI_{it}$ suggest that these variables have a significant impact on $ADULT_{it}$ in Model 2. The effect URB_{it} and LRE_{it} also had a significant effect, but only 10%. In this era of technological advancement, no economy can progress without expanding its industrial sector. Nowadays, every country in the world wants to improve its economy through industrial output. Lower-middle-income countries are also focusing on industrialization as a means of economic development. The manufacturing process necessitated the use of energy. Higher production requires more energy, which has an influence on the environment and has ramifications for human health, such as a rise in infant mortality. Each country uses the energy sources that are most readily available to it, and both types of energy have varied effects on human health. The study looks at how carbon dioxide emissions, greenhouse gas emissions, and industrialization have influenced child mortality in these countries. Unequal income distribution and low income are linked to health problems. Higher-income was connected with a lower mortality rate, while low income was associated with a higher mortality rate. As a result, we can conclude that employment has a negative relationship with death rates. Unemployed people cannot afford even the most necessities of life, but employed people may afford adequate health care, lowering mortality rates.

Conclusion

To conclude, the relationship between a clean environment, advanced health facilities, and economic growth plays an essential role in determining the development route of nations. Developing countries struggle with a multitude of challenges, ranging from climate change and political instability to massive population growth and unemployment, each impacting different sectors of their economies. Child mortality emerges as a global concern, with economic, social, and environmental factors influencing both adult and infant mortality rates. The significance of carbon dioxide in sustaining life on Earth is undeniable. Yet, its overabundance, particularly through greenhouse gas emissions, poses severe threats to ecosystems and human health, leading to the alarming reality of global warming. The study emphasizes the critical role of energy consumption in economic development, highlighting the divergence in benefits between industrialized nations favoring clean energy and developing countries dependent on cheaper, non-renewable sources with detrimental environmental and health consequences. The study recommends keen attention to environmental conservation and adopting clean energy in lower-middle-income countries to alleviate the adverse effects of greenhouse gas emissions, industrialization, and non-renewable energy usage on human health.

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