AN ANALYSIS OF LIFE EXPECTANCY, ECONOMIC GROWTH, CO2 EMISSION, HEALTH EXPENDITURE AND URBANIZATION IN THE D-8 COUNTRIES

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BY

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of my own work, and that due acknowledgement has been given in the references to ALL sources of information, be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university or other institutes of learning.

(3) The word count of this research report is 10018 words.

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DEDICATION

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
ALQI	Air Quality Life Index
ARDL	Autoregressive Distributed Lag
CO2	Carbon Dioxide Emission
D-8	Developing-8
DFE	Dynamic Fixed Effect
DOLS	Dynamic Ordinary Least Square
EPIC	Energy Policy Institute at the University of Chicago
FMOLS	Fully Modified Ordinary Least Square
GDP	Gross domestic product
HE	Health Expenditure
LE	Life Expectancy
MG	Mean Group
OECD	Organization for Economic Cooperation and Development
OLG	Overlapping Generations Model (OLG)
OLS	Ordinary Least Square
PMG	Pooled Mean Group
SBC	Schwarz Bayesian Criterion
U	Urban Population Growth
WHO	World Health Organization

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PREFACE

In this era, countries are putting efforts in boosting the economy to provide better living standard to the people. The basis for this research is stemmed from the concern over the living area and life expectancy. Nowadays, carbon dioxide emission is increasing resulting from economic activities and urbanization. Moreover, insufficient fund allocation on health expenditure is a risk on maintaining humans' well-being. It is important to curb those issues as soon as possible to lengthen human life expectancy. This research investigates the relationship between the GDP per capita growth, CO2 emissions, health expenditure, urban population growth and life expectancy in the D-8 countries. This research is expected to provide insights for the government and policymakers to design better and new policies and plannings to lengthen life expectancy.

ABSTRACT

The aim of this research is to investigate the effects of the GDP per capita growth, CO_2 emission, health expenditure, and urban population growth on the life expectancy in the D-8 countries. This research utilized panel autoregressive distributed lag model (ARDL) to investigate the relationship between the variables. This research analyses the annual data from 1991 to 2019 for a panel of D-8 countries, Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey. Our empirical findings show that the life expectancy in half of eight countries are affected by health expenditure and urban population growth. We conclude that these two variables influence the life expectancy the most in the D-8 countries. Lastly, this research provides implication for policymakers in outlining the policies in future.

Keywords: D-8 Countries, GDP per capita growth, CO_2 emission, Health Expenditure, Urban population growth, Urbanization, Life Expectancy

CHAPTER 1 RESEARCH OVERVIEW

1.0 Introduction

This chapter included an overview of this study. In section 1.1, we discussed the background of the study. Section 1.2 is the problem statement, and the motivation of this study is being discussed. The research questions and research objectives are in sections 1.3 and 1.4 respectively. The research question is the question we intend to answer while the research objective is the aim of this study. In section 1.5. the significance of the study is being discussed. The chapter layout will be shown in section 1.6, and section 1.7 is the conclusion.

1.1 Research Background

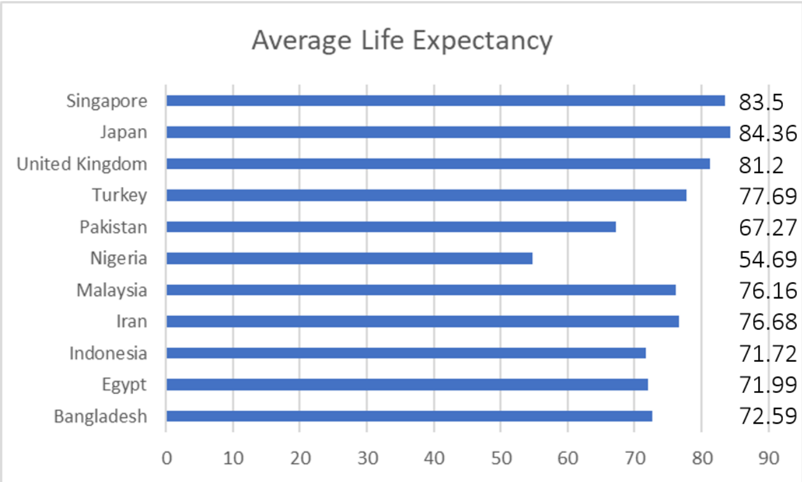
Life expectancy is one of the World Health Organization (WHO) health indicators that reflect the livelihood of human beings (Chen, Ma, Hua, Wang, & Guo, 2021). Life expectancy is important to measure the population's well-being and healthcare systems' performance in Developing-8 (D-8) countries, which included Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey. Besides, life expectancy is also used to compare the healthcare systems in the D-8 countries.

The increment of life expectancy is associated with life quality improvement, independent living capability, and economic activities in D-8 countries. In today's world, countries' economies improve with rapid industrialization by producing output for trades and high employment of labour. The rapid industrialization led to the issue of high concentrations of carbon dioxide and temperature due to emission from the manufacturing industry (Pata, 2018). The increment of temperature in the atmosphere causes global warming. When the temperature keeps increasing, there will be a spread of disease because the number of mosquitoes and ticks increases. Thus, the spread of diseases could affect human life expectancy because these diseases could kill people in serious conditions if the mosquito and tick populations are not in control ("Carbon Dioxide Pollution Effects on Health," n.d.). Furthermore, human respiratory systems were affected and caused by breathing difficulties, lung cancer, allergies, emphysema, and asthma.

Besides, developing countries tend to have much higher infant death rates and shorter life expectancy compared to developed countries. One of the facts is people in developing countries have less money to spend on health expenditure. People who earned high income have a higher health status and lower mortality. The life expectancy will be longer when the country became richer (Baird, Friedman, & Schady, n.d.). This study focuses on the relationship between the GDP per capita growth, CO2 emission, health expenditure, urban population growth and life expectancy in the D-8 countries. Thus, the D-8 countries could improve their healthcare systems and plans by life expectancy.

1.2 Problem statement

Table 1.1: Average life expectancy in different countries



Source: *World Bank*

The average life expectancy in the D-8 countries is low compared to developed countries. Table 1.1 above shows the average life expectancy in different countries. The average life expectancy in Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey are 72.59, 71.99, 71.72, 76.68, 76.16, 54.69, 67.27 and 77.69 respectively, while the average life expectancy in Singapore is higher which stated as 83.5, 84.36 in Japan and 81.2 in the United Kingdom.

The economic growth, carbon dioxide emission and urbanization impact humans' life expectancy in D-8 countries. Countries will improve their economic growth by urbanization to enhance employment and productivity. The mass production in the manufacturing sector expanded to increase the production for trade. The positive impact of urbanization is people could access infrastructure easily and lift their living standards by earning more income with employment. In contrast, manufacturing activities led to air pollution issues that affected human life expectancy. The carbon dioxide emission from manufacturing sectors affected humans' health.

According to the World Health Organization (WHO), the particulate matter concentration of PM 2.5 should not exceed 10 µg/m3 (micrograms per cubic meter). In Bangladesh, the PM 2.5 concentration per capita was recorded at 77.1 µg/m3, which was the worst record in 2020. According to the Energy Policy Institute at the University of Chicago (EPIC), the residents of the capital of Bangladesh, Dhaka, could live 7.7 years longer if the concentration levels met the WHO guideline. The Air Quality Life Index (ALQI) stated the number of motor vehicles was tripled from 2013 to 2020, the carbon dioxide emission are mainly from the usage of motor vehicles ("Report: Air Pollution May Decrease Life Expectancy in Bangladesh, Southeast Asia — BenarNews," n.d.). In Malaysia, the death rate among the elderly will increase due to the high carbon emission. There will be almost 45 deaths per 100,000 by 2080 (WHO, 2015). According to the Air Quality Life Index (ALQI), Indonesia failed to meet the WHO particulate matter concentration guideline, the high air pollution levels led to a loss average of 1.2 years of life expectancy. If the pollution levels keep rising, the residents in Jakarta are expected to lose 2.3 years of life expectancy. The Indonesian government is concerning the air quality problem and has begun to act on this serious issue. The challenge to solve the air pollution issue is economic growth (Michael Greenstone & Fan, n.d.).

Turkey is a rapidly developing country in these recent years. Due to the massive urbanization and industrialization, Turkey faces air quality problems where the concentration of PM 2.5 was recorded at 20.62 µg/m3 in 2019, which exceeds the WHO air quality guideline. Approximately 30,000 people died from air pollution-related illnesses across the country. People infected with lung cancers, asthma, and other respiratory illness due to the higher concentration of PM 2.5 in the air.

In Turkey, the industry and vehicle emissions are the main causes of air pollution ("Turkey Air Quality Index (AQI) and Air Pollution information | AirVisual," n.d.). In Pakistan, there is an estimated 90,600 deaths by 2030 due to air pollution. Household air pollution is serious in Pakistan, an estimated 68,200 children died due to respiratory infections caused by household air pollution (WHO, 2015).

Health expenditure increases life expectancy in countries where income and health are strongly correlated. High income indicated a high ability to spend on health expenditure to protect health status. Countries with higher income tend to have better health systems and institutions with higher education levels. There is approximately 3 per cent of deaths among children under the age of five in poor countries, compared to less than 1 per cent in rich countries (Baird et al., n.d.).

1.3 Research Question

This study will answer the following question:

Do the GDP per capita growth, CO2 emission, health expenditure, and urban population growth affected life expectancy in the D-8 countries?

1.4 Research Objective

The objective of this study is to examine the relationship between the GDP per capita growth, CO2 emission, health expenditure, urban population growth and life expectancy in the D-8 countries.

1.5 Significance of Study

The contributions of this study shed light on four dimensions. First, we provided a picture to the policymakers in D-8 countries in formulating policies, rules, and regulations on economic and human development activities. Human development increases peoples' financial opportunities. The ability for people to work could increase their opportunity to spend on health expenses with their income. Next, we give more information to the policymakers on medical systems in D-8 countries. Appropriate and enough fund allocation in medical systems and expenditure is the essence for lengthening peoples' life expectancy. Then, policymakers should give more attention to controlling and reducing carbon dioxide emission which is the challenge to lengthen life expectancy when running economic activities simultaneously. Additionally, this study contributes to urbanization planning in D-8 countries. The governments should innovate, design, and enhance the technology, facilities, and infrastructures in the countries to provide a better place for people to live.

1.6 Chapter Layout

The remaining parts of this paper are arranged as follows, Chapter 2 is the literature review which discusses the independent and dependent variables. Research methods, data collection and data analysis are presented in Chapter 3. In Chapter 4, the empirical results will be discussed. Lastly, Chapter 5 concludes the study and provides recommendations and implications.

1.7 Conclusion

In short, the research background and problem statement are being discussed in this chapter. The research questions and research objectives are developed for this study. Moreover, the significance of the study is elucidated in this chapter. Lastly, the chapter layout of this paper is stated clearly. In the next chapter, we are going to look for relevant literature to construct a theoretical framework for this study.

CHAPTER 2 LITERATURE REVIEW

2.0 Introduction

In section 2.1, we have a brief introduction to life expectancy. In section 2.2, we discussed the theory of life expectancy. In section 2.3, life expectancy and economic growth is being discussed. In section 2.4, we discussed life expectancy and carbon dioxide emission. Life expectancy and health expenditure were discussed in section 2.5. In section 2.6, we discussed life expectancy and urban population growth. Then, we developed the hypothesis of this research in section 2.7. The research gap is being discussed in section 2.8. Lastly, section 2.9 is the conclusion that summarizes the existing literature that we had learned.

2.1 Brief Introduction to Life Expectancy

The health of the community is important for the country's economy. Thus, the length of the human lifespan should be strengthened. Life expectancy is used to measure population wellbeing and healthcare systems' performance. Then, life expectancy is also used to compare countries' healthcare systems. Life expectancy is one of the World Health Organization (WHO) health indicators that reflect the livelihood of human beings (Chen, Ma, Hua, Wang, & Guo, 2021). There are several determinants of life expectancy, such as health status, health systems, health workforce, income inequality, demographic factors, and other socioeconomic factors (Mathers, Sadana, Salomon, Murray, & Lopez, 2001) (Bergh & Nilsson, 2010) (Paramita, Yamazaki, & Koyama, 2020).

Bergh & Nilsson (2010) analysed the relationship between globalization and life expectancy from three dimensions, which were political, social, and economic. The variables in the paper were GDP per capita, education, nutrition, sanitation, and health care availability. The result of the paper showed there was a strong relationship between globalization and life expectancy, all the variables affected life expectancy significantly. The relationship between globalization and life expectancy is strong because globalization enhanced economic growth. People earned more income through free trade, transfer of technology and competitive market. These opportunities reduce poverty, so people could have chances to access healthcare, treatments, and therapy when they are sick. Thus, people could take care of their health and their lifespan became longer. Furthermore, there is a strong relationship between poverty and health expectancy in Indonesia. From the study of Paramita, Yamazaki, & Koyama (2020), the result shows the higher the income per capita, the higher the life expectancy, this has been explored and supported in prior studies by (Bergh & Nilsson, 2010). These are the factors that affected human life expectancy significantly, countries economic growth and income are the opportunities and abilities for people to get suitable treatment in front of illness and disease to enjoy a longer life.

2.2 Theory of Life Expectancy

The defining of human life span is based on general observation, not on the empirical investigation. The measures of longevity given above relate to individuals, measures of longevity are referring to population groups. The increment of average maximum life span can provide evidence as to whether the members of a given population are tending to live longer or not (Siegel, 2012). The length of the human lifespan depends on genes, behaviour, environment, and other factors. In the second half of the 20th century, the life expectancy over the world has seen a rise. The world average life expectancy rose from 54.4 in 1960 to 71.6 in 2018 according to the data from Organization for Economic Cooperation and Development (OECD) (Cui & Chang, 2020). An extension of life expectancy is an advantage for humankind.

In this study, the overlapping generations model (OLG) is a dominating frameworks of analysis of economic growth and dynamics of macroeconomic. The OLG model is the natural framework for the research on the behaviour of life-cycle, the allocation of resources across the generations, the economic growth determinants of human history, and the fertility transition factors implications (Lim, 2020).

Cui & Chang, (2020) examined the effects of life expectancy on social welfare and economics with exogenous and endogenous variables by utilizing Diamond-type overlapping generations model. The researchers constructed a model with savings, health expenditure and life expectancy to determine whether the welfare effect of life expectancy is necessary. The result shows is contradict to the rising life expectancy does not increase with welfare necessarily. The overlapping generations model has been used in several studies, where Choi & Shin, (2015) also conducted a study with the overlapping generations model, to analyse the impact of population ageing on the growth of labour supply, capital stock, and economic growth in Korea. The ageing of the population affected the Korean economy greatly. Korea is facing a serious population ageing issue. The overlapping generation model was used to investigate the relationship between the public health insurance expansion in South Korea and the medical expenditures and aggregate savings (Lim, 2020). The result shows that the reduction in risks of health and individual medical expenditure are with the higher public health insurance benefits, but caused a moderate reduction in both individual and aggregate savings. Within the existing literature, studies utilized an overlapping generation model in their research that focused on the links between health expenditure, population, and life expectancy.

2.3 Life Expectancy and Economic Growth

Various existing studies have been conducted by researchers to analyse the relations between environmental factors, healthcare, economic growth, and life expectancy. Ibikunle (2019) used the Ordinary Least Square (OLS) and Granger causality test to examine the impact of health on economic growth. The study concluded that to achieve economic of growth, the government expenditure on health should be considered. (Alhassan, Adedoyin, Bekun, & Agabo, 2021). Economic growth could accelerate manufacturing production and business services that create new job opportunities and increase the employment rate. When the employment rate rises, people could earn income and have more purchase power. Moreover, economic growth could generate tax revenues for the government thus the government provides more investment and funds for public welfare such as enhancing healthcare systems and treatments.

The research of Yaqub et al. (2012) studied a similar focus which was that economic growth improved human life quality and living standards. Human life expectancy is strengthened when the government spend more funds generated from their economic growth on public healthcare. Therefore, the Nigerian government encouraged building a healthy population because economic growth is important to a good quality of life (Yaqub et al., 2012). According to Chen, Ma, Hua, Wang, & Guo (2021), the GDP per capita impact the life expectancy in both developing countries and developed countries significantly. This study is similar to the evidence from (Alhassan, Adedoyin, Bekun, & Agabo, 2021), which also stated that economic growth enhanced healthcare systems and treatments. The high GDP per capita in developed countries has the greatest positive impact on life expectancy. The result of the research by Chen et al. (2021) illustrated that life expectancy and GDP per capita were correlated negatively in developing countries, which contradicted some existing studies where most of the results showed there was a positive correlation between life expectancy and GDP per capita.

2.4 Life Expectancy and Carbon Dioxide Emission

In these recent years, the amount of carbon dioxide emission increases rapidly year by year due to the manufacturing sector, usage of motor vehicles, and open burning. Human health was affected by carbon dioxide which causes respiratory diseases such as asthma, coughing and lung cancer. Chen et al. (2021) stated that carbon dioxide emission harmed life expectancy in both developed and developing countries. In previous studies, the researchers believed environmental factors are one of the main factors that affected life expectancy, but some of these factors do not impact life expectancy directly. This is because the life expectancy of humans is also affected by lifestyle, genetics, hygiene, and other factors, not only the environmental factor such as air pollution including carbon dioxide emission. However, air pollution impacts life expectancy significantly in both short-term and long-term periods. The particulate matter, PMs, reduced human life expectancy where the pollutants affected human beings' health.

Moreover, Chen, Ma, Hua, Wang, & Guo (2021) examined the relationship between life expectancy and determinants of life expectancy by using multiple regression models which had been used widely in life expectancy research. The result of the study showed that carbon dioxide emission in developing countries were lower than in developed countries, but the correlation between both variables was negative in developing countries and developed countries. Furthermore, in many countries, the air pollution is the main factor that caused rapid population ageing. Han et al. (2021) analysed the population ageing and deaths attributable to ambient PM2.5 pollution. The findings from the research were estimated 8.42 million attributable deaths caused by PM2.5 in 2016, the global economic cost of deaths in the older population was US$ 2.40 trillion, ten times higher than the younger population. Therefore, we can see that Han et al. (2021) illustrated the carbon dioxide emission impact on human health and thus affected life expectancy, which is consistent with empirical evidence from Chen et al. (2021). One of the main factors is the PM2.5 pollutants cause respiratory diseases and population ageing that shorten the human lifespan.

2.5 Life Expectancy and Health Expenditure

Health expenditure included expenses for preventive and curative health services, emergency aid, nutrition, and family planning activities. Healthcare spending is important for humans to improve human capital and productivity for the economy. In this research, we want to know will the life expectancy is affected by heath expenditure and is any relationship between life expectancy and health expenditure. There were a few existing studies that investigate the relationship between life expectancy and health expenditure.

MURTHY, SHAARI, MARIADAS, & ABIDIN (2021) investigated the relationships between carbon dioxide emission, economic growth, and life expectancy by using the panel ARDL approach. From their research, the result shows that life expectancy was affected significantly by health expenditure. Moreover, Wang & Wang, n.d. studied the relationships between medical resources allocation and population health in OECD countries. The study shows the spread of illness is associated with prevention and improved productivity. The appropriate medical resources allocation will reduce the healthcare expenses for the elderly and the whole population's health. Both of the studies stated that life expectancy is affected by health expenditure. Human lifespan depends highly on government expenditure on health. Life expectancy will be longer when the government spends more health expenditure in the health sector.

In contrast, the results from Berrigan et al. (2014), mentioned that the correlation between insurance coverage and cancer mortality is negative. This means the death caused by cancer was not affected by the insurance. In addition, although the health expenditure of the United States is at a high level, the United States is not a country with a high life expectancy (Hamidi, Ewing, Tatalovich, Grace, & Berrigan, 2018) From the previous studies, we can see that all the results carried out are not consistent stated that the relationship between life expectancy and health expenditure is positive.

2.6 Life Expectancy and Urban Population Growth

According to the United Nations, the world life expectancy increased from 47 years to 72.3 years, which were in the year 1950 to 2020 respectively. The percentage of the world population over 60 is expected to rise to 15.9 per cent by 2050. Ageing societies are often seen in high-income countries at the advanced stage of demographic transition. (Doignon, Ambrosetti, & Miccoli, n.d.) Moreover, high costs in the healthcare sector are led by the increment in population ageing because older people with disability, age-related illnesses and diseases need costly medical care to longer their life expectancy.

Cervellati (2009) conducted a research to analyse the causal effect of life expectancy on economic growth for the role of the demographic transition. The researcher used demographic transition theory to study the effect of life expectancy on population, income per capita and human capital. The results concluded that the increase in life expectancy increases the population growth. However, an increase in life expectancy only affected a little human capital and decreased income per capita. Demographic transition refers to the shift from high birth rates and high death rates to low birth rates and low death rates. When health improves, the mortality rates start to drop faster than the fertility rates. This led to a short-lived increase in family size because of the lagging among mortality and fertility and then the population rise. In addition, the continuous decline of fertility rates and rising life expectancy led to population ageing. Therefore, the number of older people will more than the number of younger people in future. An ageing population was led by the decrease of younger people's population proportion (Ofori-Asensio et al., 2018). The population growth was triggered by the improvement in life expectancy (Acemoglu and Johnson, 2007). In short, the GDP per capita increased the life expectancy at birth through economic growth and development, thus leading to longevity prolongation (Miladinov, 2020). Population health and country development are hugely affected by life expectancy. That means, that when the population's health and country development improved, the mortality rate reduced, and life expectancy increased.

Urbanization is the population shift from rural area to the urban areas, the number of people living in urban areas become higher when the cities grow. Residents who live in urban areas can access infrastructure and facilities easily. Besides, urban areas provide better social services, education, and medical care to people. But the increment in urban population led to the waste-disposal problem, insufficient water availability, and the water and air quality become poorer. Urbanization population growth causes environmental and social problems due to the high density of the population. For example, air and water pollution, high crime rates and high chances of spreading diseases. According to Chen et al. (2021), there is a positive impact on life expectancy with urbanization rate in developed and developing countries.

The life expectancy performance of the United States in recent years was poor compared to other developed countries due to urban sprawl although the United States spent more on health expenditure (Hamidi, Ewing, Tatalovich, Grace, & Berrigan, 2018), which is contradict to the research from Miladinov (2020). Hamidi, Ewing, Tatalovich, Grace, & Berrigan (2018) conducted research on life expectancy and urban sprawl in the United States by structural equation modelling (SEM) with endogenous and exogenous variables that included annual vehicle miles travelled per household, crime rate, percentage of smokers, average body mass index and air quality index. The result of the study shows the relationship between life expectancy and sprawling is more significant than the relationship between life expectancy and compact. The higher rates of urbanization was led by the rising numbers of people in urban sprawl condition.

In addition, environmental issues were aggravated by urbanization due to the rise in population. Most recently, Sahoo & Sethi (2021) applied Pooled Mean Group and Mean Group (MG) in the study to examine the interaction of variables including life expectancy and population density on air quality and ecological footprint in newly industrialized countries. The result shows that urbanization and life expectancy had a positive impact on ecological footprint, which is consistent with the evidence from Chen et al. (2021).

2.7 Hypothesis Developments

This study hypothesizes that GDP per capita growth, carbon dioxide emission, health expenditure, and urban population growth are having relationships with the life expectancy in the D-8 countries. In this study, the real GDP per capita indicates the economic growth, carbon dioxide emission indicates the pollution rate in countries, health expenditure indicates the spending on healthcare, and urban population growth indicates the urbanization in D-8 countries. We developed four hypotheses to summarize the real GDP per capita, carbon dioxide emission, health expenditure, and urban population growth on life expectancy in D-8 countries.

The hypothesis of the research:

H1: There is a significant relationship between GDP per capita growth and life expectancy.

H2: There is a significant relationship between carbon dioxide emission and life expectancy.

H3: There is a significant relationship between health expenditure and life expectancy.

H4: There is a significant relationship between urban population growth and life expectancy.

The lack of existing articles focusing on urbanization on life expectancy motivated us to conduct this study to investigate the effects of these variables on life expectancy in D-8 countries. Thus, the hypothesis above is designed to analyse the relationships between the GDP per capita growth, carbon dioxide emission, health expenditure, and urban population growth on life expectancy in D-8 countries.

2.8 Research Gap

From reading the existing literature, we found there is a lack of existing articles that related to the topic which included all the variables needed to be studied in this paper. Besides, there are limited articles that involve all the eight countries from the D-8 countries. Most of the articles only analysed a few countries. Although some articles studied certain countries, but not involve all the D-8 countries. Moreover, there is a lack of existing research analysis on urbanization growth and life expectancy among the D-8 countries.

Hence, this paper set to analyse the GDP per capita growth, carbon dioxide emission, health expenditure, and urban population growth are having relationships with the life expectancy in the D-8 countries. This study aims to provide more information for policymakers to help them in systems and infrastructure planning to improve humans' life expectancy.

2.9 Conclusion

This study is to analyse the relationship between the GDP per capita growth, carbon dioxide emission, health expenditure, urban population growth and life expectancy in the D-8 countries. From the reviewing existing literature articles, researchers analysed the variables with different methods, observations, and sampling areas. There were similarities in their outcomes and results. By conducting this research, policymakers will have a clearer and more detailed picture and information to design better policies for their countries which provides better living standards for the citizens.

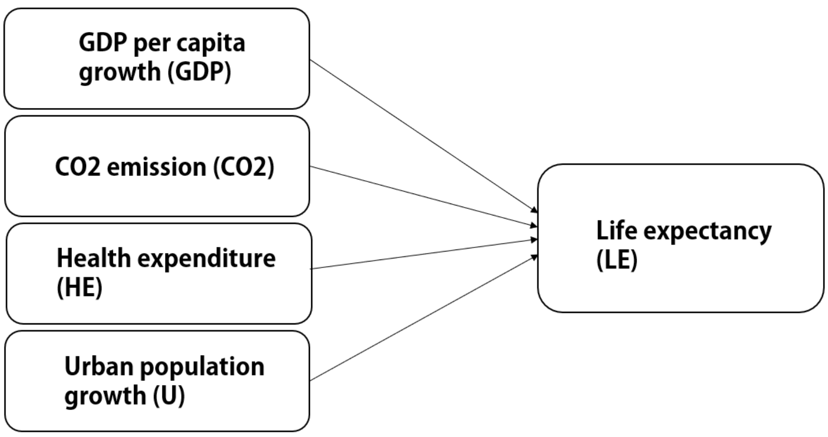
CHAPTER 3 METHODOLOGY

3.0 Introduction

In this chapter, the methodology used in this research will be described. The panel data included the sources and variables descriptions were collected. Section 3.1, is the research framework of this study. Moreover, the descriptive analysis and correlation analysis were presented respectively in section 3.2. In section 3.3, we discuss the methods used in this study. Moreover, the construction of the research model was described in section 3.4. Lastly, the conclusion is summarized in section 3.5.

3.1 Research Framework

Figure 3.1: Research Framework



Source: Developed for the research

In this study, independent variables included the GDP per capita growth (GDP), carbon dioxide emission (CO2), health expenditure (HE) and urban population growth (U). The dependent variable is life expectancy (LE). We investigate the relationships between the GDP per capita growth, carbon dioxide emission, health expenditure and urban population growth on the life expectancy in D-8 countries.

3.2 Data

This research analyses the annual data from 1991 to 2019, 30 years for a panel of D-8 countries, Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey. The dependent variable in this study is LE (Life expectancy), while the four independent variables included GDP (GDP per capita growth), CO2 (Carbon dioxide emission), HE (Health expenditure), and U (Urban population growth). The data were collected from the World Bank Database. Table 3.2 outlines the descriptions of all the variables.

Table 3.2: Data and sources

Variables	**Abbreviation**	**Descriptions**	**Source**
Life expectancy at birth (total years)	LE	The number of years a newborn would live throughout its life.	World Bank Database
GDP per capita growth (annual %)	GDP	Gross domestic product divided by midyear population.	World Bank Database
CO2 emission (metric tons per capita)	CO2	The production of carbon dioxide from the burning of fossil fuels.	World Bank Database
Health expenditure (% Gross Domestic Product)	HE	The expenditures for the provision of health services, family planning activities, nutrition activities and emergency aid.	World Bank Database
Urban population growth (annual%)	U	Urbanization that occurs when there is a shift in population from a rural to urban area and causes certain areas become densely populated.	World Bank Database

Source: Developed for the research

The data analysis program, Stata, is used to analyse the panel data in this study. Methods used in this study are Mean Group (MG), Pooled Mean Group (PMG), Dynamic Fixed Effect (DFE), Dynamic Ordinary Least Square (DOLS), and Fully Modified Ordinary Least Square (FMOLS). The PMG approach was used to estimate the dynamic heterogeneous panels to assess the GDP per capita growth, carbon dioxide emission, health expenditure and urban population growth on the life expectancy. Moreover, the panel cointegration tests are powerful because allowing to combine both cross-section and time dimensions information. Increase the number of observations is allowed. Before running methods of MG, PMG, DFE, DOLS, and FMOLS, I performed data analysis which included descriptive statistics by general data, descriptive statistics by countries, and correlation matrix as preliminary analysis.

3.2.1 Descriptive Analysis

The descriptive analysis of raw data was conducted before statistical analysis. Mean, Standard deviation, Minimum, and Maximum were acquired by running a descriptive analysis. Moreover, the descriptive analysis provided information that would help the researchers have a better understanding of the data by reading the overview of data distribution. In addition, the correlation matrix helps to identify the correlations among the variables.

Table 3.2.1 (a): Descriptive statistics by general data

Variable	Obs	Mean	Std. Dev.	Min	Max
LE	148	68.32484	7.334984	46.835	77.691
GDP	148	3.130027	2.836248	-8.553	12.457
CO2	148	2.868348	2.46417	0.17	7.883
HE	148	3.738512	1.178393	1.853	6.759
U	148	2.884155	0.8614803	1.732	4.846

Source: Developed for the research

Table 3.2.1 (a) above shows the descriptive statistics by general data. There are 148 observations in total after the outlier from 8 countries in 30 years. Overall, there are small differences between maximum and minimum in the variables, which indicated the gap between the countries is small.

Table 3.2.1 (b): Descriptive statistics by countries

Variable		Mean	Std. Dev.	Min	Max	Observations
LE	overall	68.32484	7.334984	46.835	77.691	N=148
	between		7.647753	50.95106	74.30879	n=8
	within		1.790867	63.65909	72.06078	T-bar=18.5
GDP	overall	3.130027	2.836248	-8.553	12.457	N=148
	between		1.081901	1.9504	5.233062	n=8
	within		2.661793	-7.537573	12.63564	T-bar=18.5
CO2	overall	2.868348	2.46417	0.17	7.883	N=148
	between		2.650801	0.366125	6.779733	n=8
	within		0.4890187	1.281615	3.971615	T-bar=18.5
HE	overall	3.738512	1.178393	1.853	6.759	N=148
	between		1.197356	2.538406	5.6921	n=8
	within		0.4397905	2.566101	5.129101	T-bar=18.5
U	overall	2.884155	0.8614803	1.732	4.846	N=148
	between		0.865794	1.98105	4.623667	n=8
	within		0.3182836	2.094313	4.302905	T-bar=18.5

Source: Developed for the research

Table 3.2.1 (b) shows the descriptive statistics by country. There are 148 observations in total after the outlier from 8 countries in 30 years. The variable, life, has the highest maximum and minimum which are 77.691 and 46.835 respectively, with an average of 68.32484. Overall, there are small differences between maximum and minimum in the variables, which indicated the gap between the countries is small. The standard deviation of the variables is 2.836248, 2.46417, 1.178393, 0.8614803 for GDP, co2, he and, urban, respectively.

3.2.2 Correlation Analysis

The correlation analysis examined the depth of the relationship between the variables, where high correlation indicates the variables have a strong relationship with each other; while low correlation indicates the variables have a weak relationship with each other.

Table 3.2.2: Correlation Matrix

	lnLE	lnGDP	lnCO2	lnHE	lnU
lnLE	1.0000				
lnGDP	-0.0228	1.0000			
	0.7831				
lnCO2	0.6161*	-0.1288	1.0000		
	0.0000	0.1188			
lnHE	0.1744*	-0.2379*	0.5626*	1.0000	
	0.0340	0.0036	0.0000		
lnU	-0.7306*	0.1408	-0.6450*	-0.5906*	1.0000
	0.0000		0.0000	0.0000	

Source: Developed for the research

Table 3.2.2 is the Correlation Matrix that shows the correlation between the variables. The correlation analysis has shown the lnLE increase along with the rise of lnCO2 and lnHE, but decreases along with lnGDP and lnU. The lnGDP has a negative relationship with lnCO2 and lnHE, but has a positive relationship with lnU. The lnCO2 have a positive relationship with lnHE but has a negative relationship with lnU.

3.3 Methods

A panel Autoregressive Distributed Lag model (ARDL) is used to analyse the data in this study. The dynamic heterogeneous panels of a Mean Group (MG) and Pooled Mean Group (PMG), and Dynamic Fixed Effect (DFE) techniques were being used in this study. In addition, the selection between PMG or MG and PMG or DFE is selected by using the Hausman test. The situation of PMG is more favourable than MG, or MG is more favourable than PMG, is according to the he acceptance or rejection of the null hypothesis between PMG and MG. On the other hand, the more favourable of PMG compared to DFE, or the DFE is more favourable than PMG, is based on the acceptance or rejection of the null hypothesis between PMG and DFE respectively. Before the Hausman test, lag lengths for both MG and PMG were selected based on Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC).

The PMG approach considers the long-run equilibrium relations and estimates dynamic heterogeneous panels. The PMG approach constrained the long-run coefficients to be identical but allowed time trends, intercept, and short-run parameters to differ across groups. Based on Pesaran et al. (1999), assuming identical short-run coefficients error variances across groups is less compelling. The PMG approach does not assume homogeneous short-run parameters and allows identical long-run coefficients. On the other hand, the MG approach computed means of coefficients and estimated regression for each group, but it is inefficient when holding homogeneity although the long-run estimators of MG are consistent. Thus, the PMG approach is preferable under these conditions. Furthermore, the DFE method also consists of data pooling, error variances and assuming identical regression coefficients.

3.4 Empirical Model and Model Construction

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

$$Y = \beta_0 + \beta_1 GDP + \beta_2 CO2 + \beta_3 HE + \beta_4 Urban + \varepsilon \quad (2)$$

In this model, Y represents the life expectancy, X_1 represents the real GDP per capita, X_2 represents carbon dioxide emission, X_3 represents health expenditure and X_4 represents urban population growth. Next, we wish to estimate the panel autoregressive distributed lag (ARDL) model. Based on Pesaran et al. (1999), there are three estimators, which included mean group (MG), pooled mean group (PMG), and Dynamic Fixed Effect (DFE) estimators. The MG and PMG are the dynamic panel estimators which are consistent when both T (time) and N (cross-sections) are large. The DFE is an alternative estimator proposed under the presumption of the homogeneous slope, which is fixed, and the intercepts can change across the cross-sections.

By following Pesaran et al. (1999), the given data on periods, t = 1,2…, T, and groups, I = 1,2…, N, is to estimate an ARDL (p, q, q,…q) model,

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} x_{i,t-j} y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij} x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (1)$$

$$\Delta y_{it} = \phi_i y_{i,t-1} + \beta_i' + \sum_{j=1}^{p-1} \lambda_i \times {}_j\Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_i \times {}_{t-j}{}' \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (2)$$

$$\mathrm{I} = 1, 2 \ldots \mathrm{N}, \text{and } \mathrm{t} = 1, 2 \ldots \mathrm{T}, \text{where } \phi_i = \left(1 - \sum\nolimits_{j=1}^{p} \lambda_{ij}\right),$$

$$\beta_i = \sum\nolimits_{j=0}^{p} \delta_{ij} x_{i*j} = \sum_{m=j+1}^{p} \lambda_{im}, \quad (3)$$

$$j = 1, 2, \ldots, p-1 \text{ and } \delta_{i \times j} = -\sum_{m=j+1}^{q} \delta_{im} \quad j = 1, 2, \ldots, q-1$$

where x_{it} (k × 1) refers to the vector of independent variables for group i; μ_i signifies the fixed effects; the coefficients of lagged dependent variable x_{ij} are scalars; and δ_{ij} are k × 1 coefficient vectors. T must be adequately large to estimate each group independently. Equation (1) is to measure the long-run effect, while Equation (2) is to measure the short-run effect, and Equation (3) shows the coefficients of the variables.

The best combination of ARDL is chosen based on the smallest value, ARDL (1,0,0,0,0) is chosen in this study, which with the smallest value of SBC and AIC. Besides, alternative panel estimation techniques of panel cointegration, Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square (FMOLS) were also applied in this study.

3.5 Conclusion

In this chapter, the data in this study was described clearly. Descriptive and correlation analysis gave us a better understanding of the data collected. Besides, the methods of MG, PMG, DFE, DOLS, and FMOLS help us to choose the best results for this study to do analysis.

Chapter 4 EMPIRICAL RESULTS AND DISCUSSION

4.0 Introduction

In this chapter, we discuss the findings of the study. In section 4.1 and section 4.2, we discussed the baseline results and baseline results by country, respectively. In section 4.3, we have a discussion. Lastly, the conclusion was summarised in section 4.4.

4.1 Baseline Results

This study investigates the relationships between the independent variables, which included the GDP per capita growth (GDP), carbon dioxide emission (CO2), health expenditure (HE) and urban population growth (U), and the dependent variable, which is the life expectancy (LE), over the annual period from1991 to 2019 in the D-8 countries. The D-8 countries included Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey. We could not consider a longer period due to there is no available data for some variables in some number of years. However, this 30 year period is enough for us to investigate the long-run effect of the panel framework in this study.

Table 4.1 shows the results obtained from MG, PMG, DFE, DOLS and FMOLS estimators that resulted in the best outcome for this study. The time trend lowered the standard errors and decreases the speed of convergence significantly by imposing long-run homogeneity on the coefficients. By the Hausman test, the restriction could not be rejected at the conventional statistical level. On contrary, the DFE estimator gave a slower convergence speed because of the downward bias in dynamic heterogeneous panels. In addition, the restrictions of short-term dynamics affected the long-run coefficient's sign and significance.

Table 4.1: Baseline estimates (dependent variable: Δlog Y)

	MG	PMG	DFE	DOLS	FMOLS
Convergence coefficient					
$\ln GDP_{-1}$	-0.0186	-0.0061**	-0.0210***		
	(-0.0148)	(-0.0028)	(-0.0028)		
Long-run coefficients					
lnGDP	-0.1020	0.0134	-0.0130	-1.2155	1.9079
	(0.1030)	(0.0174)	(0.0102)	(0.3794)	(0.0016)
lnCO2	-0.1890	-0.0640	-0.0426	3.4301	2.2334
	(0.2370)	(0.0774)	(0.0280)	(0.0090)	(0.0160)
lnHE	0.0149	0.367***	0.0995***	5.6536	7.5314
	(0.0895)	(0.1030)	(0.0351)	(0.0043)	(0.0000)
lnU	-0.6820	0.391***	0.0310	13.0315	8.5160
	(0.4410)	(0.1260)	(0.0345)	(0.0003)	(0.0000)

Short-run coefficients					
Δ lnGDP	-0.0007	-0.0008	0.0001		
	(0.0006)	(0.0006)	(0.0002)		
Δ lnCO2	-0.0002	-0.00436*	-0.0018*		
	(0.0011)	(0.0025)	(0.0010)		
Δ lnHE	-0.0002	0.0003	-0.00239***		
	(0.0006)	(0.0010)	(0.0006)		
Δ lnU	0.0468	0.0172	0.00472***		
	(0.0420)	(0.0204)	(0.0014)		
No. of countries	8	8	8	8	8
No. of obs.	139	139	139	139	139
Log-likelihood		979.09910			
Hausman Test	89.65 (0.0000)				

All equations include a constant country-specific term. Standard errors are in parentheses.

*Significant at the 10% level: **at the 5% level; ***at the 1% level.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Developed for the research

Table 4.1 above shows the result of panel ARDL (1,0,0,0,0) using three estimators, included MG, PMG, and DFE. Based on the PMG estimator, in the long-run, lnHE have a significant impact on lnLE. The coefficient value is stated as 0.367, indicates that a 1% increase in health expenditure will increase life expectancy by 0.367%. This result is consistent with DFE estimator. Based on DFE estimator, the value of coefficient is recorded as 0.0995, indicates a 1% increase in health expenditure will increase life expectancy by 0.0995%. Moreover, based on the PMG estimator, lnU have a significant impact on lnLE in the long-run. The value of coefficient is 0.391, which means a 1% increase in urban population growth will increase life expectancy by 0.391%. While in short run, lnCO2 have a significant and negative impact on lnLE by using PMG estimator. The coefficient value is -0.00436. This indicates that a 1% increase in carbon dioxide will decrease life expectancy by 0.00436%. Based on DFE estimator, lnCO2 have a significant and negative impact on lnLE which is consistent with the PMG estimator. The coefficient value is -0.0018. This indicates that a 1% increase in carbon dioxide will decrease life expectancy by 0.0018%. Other than that, lnHE and lnU are having significance to life expectancy in D-8 countries in short-run based on DFE estimator. These suggest that both, lnHE and lnU can influence the life expectancy. The coefficient value of lnHE is -0.00239, indicates a 1% increase in health expenditure will decrease life expectancy by 0.00239 %. While the coefficient value of lnU is 0.0047, indicates a 1% increase in urban population growth will increase life expectancy by 0.0047%. Based on the MG estimator, there is no significant and effect on all variables in the D-8 countries, this same goes to FMOLS and DOLS estimators. The Hausman test is conducted to choose either MG or PMG in this study. The probability value is significant. Thus, MG is better than PMG. Therefore, the MG estimator will be selected in this study.

4.2 Baseline Results by Countries

The Hausman test shows the MG estimator is more suitable than the PMG estimator in this study. Table 4.2 shows the baseline estimates by countries, which present the short-run coefficients for the D-8 countries, included Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey.

Table 4.2: Baseline estimates by countries (dependent variable: Δlog Y)

	Bangladesh	Egypt	Indonesia	Iran
Convergence coefficient				
$lnGDP_{-1}$	-0.0135***	0.00192**	-0.0183***	-0.0008
	(0.0052)	(0.0009)	(0.0051)	(0.0028)
Short-run coefficients				
Δ lnGDP	-0.00445**	-0.0003	-0.00177*	0.0000
	(0.0022)	(0.0003)	(0.0009)	(0.0001)
Δ lnCO2	-0.0014	-0.0004	0.0008	-0.0205***
	(0.0027)	(0.0010)	(0.0010)	(0.0053)
Δ lnHE	0.00618**	0.00221***	-0.00214***	-0.0008
	(0.0029)	(0.0005)	(0.0007)	(0.0011)
Δ lnU	-0.0142*	0.0000	0.00372***	-0.0062
	(0.0078)	(0.0012)	(0.0008)	(0.0071)

	Malaysia	Nigeria	Pakistan	Turkey
Convergence coefficient				
ln GDP_{-1}	-0.000960*	-0.0039	0.0004	-0.0138***
	(0.0005)	(0.0032)	(0.0034)	(0.0038)
Short-run coefficients				
Δ lnGDP	0.0001	-0.0009	0.0014	-0.0001
	(0.0001)	(0.0006)	(0.0011)	(0.0001)
Δ lnCO2	0.0001	-0.0020	-0.00837**	-0.00308**
	(0.0005)	(0.0012)	(0.0036)	(0.0013)
Δ lnHE	0.0003	-0.00340***	-0.0007	0.0006
	(0.0005)	(0.0009)	(0.0017)	(0.0021)
Δ lnU	-0.0003	0.159***	-0.0099	0.00540**
	(0.0005)	(0.0517)	(0.0149)	(0.0025)

All equations include a constant country-specific term. Standard errors are in parentheses.

*Significant at the 10% level: **at the 5% level; ***at the 1% level.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Developed for the research

The result in Table 4.2 is based on the MG estimator. In Bangladesh, lnGDP and lnU have a significant and negative impact on lnLE. The coefficients value are -0.00445 and -0.0142 respectively. This indicates that a 1% increase in lnGDP will decrease life expectancy by 0.00445%. This also indicates a 1% increase in lnU will decrease life expectancy by 0.0142%. lnHE have a significant and positive impact on lnLE. The coefficient value is stated as 0.00618, indicates that a 1% increase in lnHE will increase life expectancy by 0.00618%. The result in our study is indirectly supported by Cervellati (2009) where the researcher studied the effect of life expectancy on population, income per capita and human capital, concluded when health improves, the mortality rates dropped. In Egypt, lnHE have a significant and positive impact on lnLE. The coefficient value is 0.00221. This indicates that a 1% increase in lnHE will increase life expectancy by 0.00221%. Prior research by MURTHY, SHAARI, MARIADAS, & ABIDIN (2021) indirectly supported our results by life expectancy was affected significantly by health expenditure, but contradicted to the results from Berrigan et al. (2014) which suggested that death was not affected by the insurance.

In Indonesia, lnU have a significant and positive impact on lnLE, which the coefficient value stated as 0.00372, means that a 1% increase in lnU will increase life expectancy by 0.00372%. On the other hand, lnGDP and lnHE in Indonesia have significant and negative impact on lnLE, same with Bangladesh. This findings are consistent with prior research research by Chen et al. (2021) that illustrated that life expectancy and GDP per capita were correlated negatively in developing countries. In contrast, the finding of lnGDP have negative impact on life expectancy in Bangladesh and Indonesia is contradict to Miladinov (2020) which supported the GDP per capita increased the life expectancy at birth through economic growth thus leading to longevity prolongation.

The coefficient value is -0.00177 and -0.00214 respectively. This indicates that a 1% increase in lnGDP and lnHE will decrease life expectancy by 0.00177 % and 0.00214% respectively. After that, lnCO2 in Iran have a significant and negative impact on lnLE with the coefficient value of -0.0205 suggest that a 1% increase in lnCO2 will decrease life expectancy by 0.0205%. This result is consistent with Pakistan and Turkey, suggest that lnCO2 influence the life expectancy in Iran, Pakistan, and Turkey. These findings supported by the research demonstrated by Han et al. (2021), proved the carbon dioxide influenced human health and thus affected the life expectancy. The coefficient value of lnCO2 in Pakistan is -0.00837, which indicates a 1% increase in lnCO2 will decrease life expectancy by 0.00837%. In Turkey, the coefficient value of lnCO2 is -0.00308. This indicates that a 1% increase in xxx will decrease life expectancy by 0.00308 %, lnCO2 have a significant and negative impact on lnLE.

Additionally, in Turkey, lnU have a positive impact on lnLE with the significant coefficient value of 0.00540 that indicates a 1% increase in lnCO2 will increase life expectancy by 0.00540%. In Nigeria, lnHE have a negative and significant impact on lnLE, same as Indonesia. The coefficient value of lnHE in Nigeria is -0.00340. This finding suggests that a 1% increase in lnHE will decrease life expectancy by 0.00340%. This finding is contradicted with empirical evidence from Yaqub et al. (2012), which suggested thae good quality of life contributed by economic growth. lnU in Nigeria have a significant and positive impact on lnLE same as Indonesia and Turkey. The coefficient value is stated as 0.159. This means that a 1% increase in lnU will increase life expectancy by 0.159%. These findings explained that the urbanization rate had a positive impact on life expectancy, which consistent with the empirical evidence carried out by Chen et al. (2021) and Sahoo & Sethi (2021). Lastly, this section is extended to the discussions in the next section, which is in section 4.3.

4.3 Discussion

In Bangladesh, the GDP per capita growth, health expenditure and urban population growth are significant to life expectancy, where the GDP per capita growth and urban population growth decrease the human life expectancy, while the health expenditure increases the life expectancy. Recently, Bangladesh’s economy and population have grown rapidly due to economic development. Higher GDP growth in Bangladesh in these recent years because of agriculture activities. Besides, industry sectors created job opportunities for people and increased their living standards. However, Bangladesh still struggling with poverty despite the rapid economic growth in the country. While job opportunities have been improved in Bangladesh, the employment rate in Bangladesh is still low. The poverty rates dropped in Bangladesh’s economic improvement. Due to these reasons, people in Bangladesh who live in extreme poverty suffer from undernourishment. They could not consume enough nutritious food and thus, their life expectancy decreases. Although the Bangladesh economy develops rapidly, poverty in the country still exists (“Life Expectancy in Bangladesh - The Borgen Project,” n.d.). To improve life expectancy in Bangladesh, employment is important for people to earn more money so people could have the ability to spend on health expenses. The effective policy implemented by the government to increase per capita real income and allocate sufficient expenditure on health systems, are essential to humans’ wellbeing. Social development and urban population planning could help Bangladesh to lengthen its life expectancy (Mahumud, Rawal, Hossain, Hossain, & Islam, 2013).

In Egypt, health expenditure is significant to life expectancy, which increases human life expectancy. According to the World Bank, public spending on health in Egypt decreased from 5.8% of the GDP in 2002 to 4.1% in 2015. However, there is a small improvement in their health performance, although there was a reduction in the government spending on health expenditure ("(PDF) Relationship between Health expenditure and Economic growth in Egypt from 1990 to 2016," n.d.). The Ministry of Health and Population (MOHP) of Egypt organized an immunization program to increase vaccination coverage in the country. This program aimed to stop vaccine-derived poliovirus (cVDPV) transmission (*Project Information SCOPE OF WORK*, n.d.). Furthermore, Egypt had a significant health status improvement for the people of its population in the past few decades. For instance, the Egyptian Health Sector Reform Program (HSRP) was strengthened with improved access and coverage for low-income groups and the benefits package was expanded. There are several options are available for people, including primary basic speciality and inpatient care (Gaumer & Rafeh, 2005).

In Indonesia, the GDP per capita growth, health expenditure and urban population growth are significant to life expectancy. The GDP per capita growth and health expenditure decrease the human life expectancy. There is only one hospital bed per 1,000 people, 25 doctors per 100,000 people in Indonesia ("Indonesia's Failing Healthcare Industry and How Medical Tourism Can Help," n.d.). Indonesia is lacking medical supplies, equipment, and doctors in their healthcare industry. The disparity between rich and poor in Indonesia is wide. People who live in poverty could not afford to pay expensive medical bills, so they do not seek a doctor when they are sick. Serious illness would take peoples' lives and long-term illness will shorten their lives. Not enough funds are allocated to the healthcare system, the government should take action in infrastructure and facilities improvement, and reform pharmaceutical and medical for people to live a better life and increase their life expectancy. On the other hand, the life expectancy in Indonesia increases due to the urban population growth. In 2015, approximately 70 per cent of the Indonesian population were in the productive age, which is between 15 and 64. People of productive age rise the productivity and contribute to economic growth in the country (Ziegenhain, n.d.). Economic growth provided better lives for citizens when they have more money could be spent to improve living standards.

In Iran and Pakistan, carbon dioxide emission is significant to the life expectancy in both countries. The carbon dioxide emission decrease life expectancy. According to Mamipour, Beheshtipour, Feshari, & Amiri (2019), carbon dioxide emission are affected by GDP per capita and urbanization in Iran. The rising economic development and urbanization increased pollution levels that affected human health in the country. The economic and urbanization activities increased pollutants concentration in Iran. People who lived in polluted areas will have a high risk to infect with life-threatening diseases, such as respiratory diseases, cancers, Malaria, and dengue fever (Mousavi et al., 2020). In Pakistan, the air quality is unsafe because the air concentration exceeded the recommended maximum of 10 µg/m3 ("Pakistan: Air Pollution | IAMAT," n.d.). A major health challenge faced by people in Pakistan is air pollution. Solid waste burning, and vehicle and industrial emissions are the main carbon dioxide contributors to the poor air quality in Pakistan. The air pollution issues in Pakistan are concerning because it harm human health status and length of lives.

Long periods expose to air pollution will resulting on lung cancer, asthma, and other respiratory illness, because these diseases will shorten human life expectancy. People in Pakistan are highly encouraged to wear face masks. In Pakistan, one in ten deaths in children under the age of five is caused by air pollution ("Why Pakistan has some of the most polluted cities in the world | Asia | An in-depth look at news from across the continent | DW | 01.11.2021," n.d.). Additionally, farmers in Pakistan burn their fields to prepare more space for planting. The Pakistan government should implement policies, rules and regulations to these practices that harm human health. To curb air pollution issues in both countries, installation of emissions-reducing technology to replace old technologies is a must for them to reduce the serious air pollution.

In Malaysia, no variable is significant to life expectancy. The life expectancy in Malaysia is approximately 76.16 years. The government of Malaysia and the Ministry of Health (MOH) developed social programs to protect wellbeing and quality of life in Malaysia. Besides, legislation was designed and implemented to improve human health, safety, and security. In addition, nongovernmental organizations in Malaysia put efforts into poverty reduction through skills training, education, and financial literacy programs. Underprivileged families benefited from financial aid and the poverty rate in Malaysia had reduced. The government had put effort into social programs to address poverty in the community. These advantages given by the government and non-governmental organizations give people in Malaysia enjoy a better quality of life ("10 Facts About Life Expectancy in Malaysia - The Borgen Project," n.d.).

In Nigeria, the urban population growth is the only variable that is significant to the life expectancy, which the urban population growth increases the life expectancy. Nigerian society is rapidly becoming urban in these recent years. The country undergoes rapid urbanization with a rapidly growing population. Urbanization brings social and economic advantages, for example, better healthcare, transportation, opportunities, and education. Furthermore, urbanization implies the free movement of people, goods, and services within the country. The modernized society creates more employment opportunities for people to work. A modernized area developed with technology-savvy, enhanced medical facilities, and better educational facilities ("Causes, Effects and Solutions to Urbanization Leading to Urban Growth - Conserve Energy Future," n.d.). In short, better social life in general. As a result, people in Pakistan are living longer life expectancies with urbanization.

In Turkey, two variables are significant to life expectancy, which are carbon dioxide emission and urban population growth. The carbon dioxide emission decreases the life expectancy, while the urban population growth increases the life expectancy. Severe air pollution in Turkey is alarming and caused by overpopulation. In Pakistan, approximately 30,000 people die from air pollution-related illnesses each year. According to Turkey's Environment, Urbanization and Climate Change Ministry, air pollution has been at a high level recently in several districts in Turkey. There are approximately 4.5 million motor vehicles in the metropolis, and around 3.2 million of which are automobiles ("High level of air pollution in Istanbul worries experts - Turkey News," n.d.). People in Turkey should travel by public transportation such as rail systems instead of their vehicles. The government and experts have to design and implement new restrictions on traffic to address the serious air pollution in the country. The quality of life in Pakistan should be improved as soon as possible by addressing air pollution problems. Social planning and traffic planning is the major priority for the Turkish government to lengthen people's life expectancy ("Addressing the Challenges of Urbanization," n.d.).

4.4 Conclusion

In short, we discussed the results in this chapter. From the findings, we observed the first hypothesis is supported by Bangladesh and Indonesia, where there is a significant relationship between GDP per capita growth and life expectancy. Then, the second hypothesis is supported by Iran, Pakistan and Turkey, where these countries indicated there is a significant relationship between carbon dioxide emission and life expectancy. Moreover, the third hypothesis is supported by Bangladesh, Egypt, Indonesia, and Nigeria, where there is a significant relationship between health expenditure and life expectancy in these four countries. Lastly, the fourth hypothesis is supported by Bangladesh, Indonesia, Nigeria, and Turkey, where there is a significant relationship between urban population growth and life expectancy.

Chapter 5 IMPLICATIONS AND CONCLUSION

5.0 Introduction

This chapter summarizes what we had done in this research. The conclusion of this study were summed up in section 5.1. The implications of the findings were discussed in section 5.2. Meanwhile, we discussed the limitations of the study in section 5.3. Lastly, the recommendations for the future study were provided in section 5.4.

5.1 Conclusion

Life expectancy is important to measure the population's well-being and healthcare systems' performance. The length of life expectancy indicates human well-being in living with better healthcare in their countries. Life expectancy increases with the improvement of life quality, the capability for independent living, and booming economic activities in countries. Moreover, lengthen the life expectancy could enhance countries’ productivity within productive age of people. The process of lengthening life expectancy is a cycle.

Previous existing results provided inconsistent results has motivated us to conduct this study. Hence, this study is carried out to investigate the relationship between the GDP per capita growth, carbon dioxide emission, health expenditure, urban population growth and the life expectancy in D-8 countries over the period from 1991 to 2019. This research investigates the relationships between the dependent and independent variables by utilizing the ARDL model in the analysis and applying theory of overlapping generations model. Furthermore, we further study the effects on life expectancy in D-8 countries with urban population growth which represent urbanization, which does not exist in previous research. We intend to analyse on urbanization is because this factor gives influences on other variables that connects to various extends. Last but not least, in future, urbanization is a hot topic in developing countries to improve the economies.

In this study, the result illustrated that health expenditure and urban population growth are the factors that affected more on life expectancy in D-8 countries. The life expectancy in four out of eight countries is affected by health expenditure and urban population growth, although the air pollution is quite high in the countries. Besides, the life expectancy in two out of eight countries was affected by economic growth, and the life expectancy in three out of eight countries was affected by carbon dioxide emission. The eight countries of life expectancy is not only stick into one variable and biased, there are several variables that influence the life expectancy in the D-8 countries.

In future, the government and policymakers in D-8 countries should improve on handling economic activities, CO2 emission issues, the amount of health expenditure, and urbanization planning, to lengthen humans' life expectancy, such as designing a new and more effective plan. In addition, the government of D-8 countries should seek assistance from the international community if they have difficulties in solving the issues.

5.2 Implications of Study

Lengthening life expectancy in D-8 countries is necessary to give people a better life. Thus, policymakers in D-8 countries should be concerned about their own countries' life expectancy and design regulations to improve livings quality. Then, they could also have a better ability to compete in the global market. Higher environmental and living quality lengthen the life expectancy.

Our findings have supported a few implications. First and foremost, there are several policies that we could derive from the findings above. The government in D-8 countries should raise awareness of the effects of carbon dioxide on life expectancy among the citizens, for instance, organize campaigns to promote awareness of air pollution via different platforms, such as online platforms, television, and other influencing media platforms. Additionally, policymakers should design a more suitable urbanization plan in their countries to lengthen life expectancy, so their citizens could live in a better environment and enjoy the infrastructures. Moreover, we validated the significant relationship between health expenditure and life expectancy. This finding indicated that we should not underestimate the effects of healthcare spending on life expectancy. The governments should allocate the appropriate amount of funds to the health expenditure in the countries to protect human health and living.

Last but not least, our findings also illustrate that economic growth also has an impact on the life expectancy in D-8 countries. This is due to the urbanization population growth and carbon dioxide affects the economic growth, because when the urbanization population growth rise, people could be able to be employed in various sectors such as the manufacturing sector, then the carbon dioxide emission will rise due to the operations of factories. Consequently, humans' health was affected and may shorten their life expectancy with less health expenditure. Hence, policymakers need to design policies and adopt the policies without delay.

5.3 Limitation of Study

There are some limitations faced in this study. First, the data is limited, where the health expenditure data from 1990 to 1999 of all the D-8 countries which are Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan, and Turkey, are not available from sources. This obstacle could be eliminated when the data is available in future.

5.4 Recommendations for Future Study

Since we had faced limitations in this study as we had mentioned in section 5.3, we have some recommendations for future researchers to make improvements to our study. We recommend that future researchers who intend to study this topic could use other independent variables instead of health expenditure because there was a 10-year data gap for all the D-8 countries. But this limitation may be eliminated when the data is available in future. Second, I suggest future researchers use a larger sample size of countries and other econometrics methods to research this topic, so there will be more information could be acquired. Thus, the research could provide a more useful and clearer implication for the policymakers in outlining the policies and planning.

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