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DETERMINANTS OF LIFE EXPECTANCY AT BIRTH: A PANEL DATA STUDY OF LOW-MIDDLE INCOME COUNTRIES OF ASIA

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ABSTRACT

The objective of this investigation is to ascertain the impact of a variety of socioeconomic determinants on life expectancy in 18 low-income countries in Asia from 2005 to 2021. The coefficients were determined using the panel corrected standard errors and feasible generalised least square method. Life expectancy is significantly influenced by mortality due to non-communicable diseases, neonatal mortality rate, fertility rate, and availability of physicians. Urbanization and age dependency were deemed to be insignificant when determining life expectancy. The life expectancy can be increased by the implementation of appropriate policies that assure a reduced infant mortality rate, a higher employment rate, early diagnosis, prevention, and treatment of cancer and cardiovascular diseases.

Keywords: Life Expectancy, Panel Corrected Standard Errors and Feasible Generalised Least Square Method, Reduced Mortality Rate

1. INTRODUCTION

The tremendous rise in life expectancy in the previous two centuries is one of humanity's major accomplishments. The typical lifespan of an individual after reaching a specific age is known as their life expectancy. The average lifespan from the moment of birth is the most popular metric. One way to look at life expectancy is as a projection of the mean age at death for a specific population (Esteban 2017). According to Max Roser in 2020. Globally, the average life expectancy at birth for both men and women has risen from 46.5 years in 1950 to 71.7 years in 2022, and it is expected to reach 77.3 years by 2050 according to the Population Division of the United Nations. Furthermore, it is worth noting that the disparity in life expectancy across different regions is narrowing. Asia is leading, with a life expectancy increase from 42.02 in 1950 to 73.83 in 2021, quickly coming up to North America and Europe. The mean lifespan in Asia is anticipated to reach 80 years by 2050 and 85.53 years by 2100. Improved living conditions, more access to healthcare, and new technologies are all factors in this upward trend.

Life expectancy is a measure of a country's social and economic standing as well as the standard of its healthcare system and public health. (Hendi and Ho, 2018). According to one definition, life expectancy is "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." WHO (2006). The shift to sustained income growth is ultimately triggered by a sufficiently high life expectancy (Matteo et al. 2009).

According to the Global Burden of Disease Study 2021, when age-adjusted, the top four causes of death globally in 1990 and 2019 were lower respiratory infections, chronic obstructive pulmonary disease, stroke, and ischemic heart disease.

There are various determinants of life expectancy. The review of literature shows that many studies have been conducted so far to study several factors that have significant influence on life expectancy.

2. REVIEW OF LITERATURE

A summary of the key theoretical viewpoints linking distribution of income, education, occupational class, and wealth to better survivorship was presented in the article by Van Raalte AA & Seaman R (2020). Pedro Antonio et al (2021) concluded that higer life expectancy can be achieved by public spending on social security programs. Lower health spending in Canadian provinces was linked to a higher infant mortality rate and a lower life expectancy, according to Cremieux et al. (1999, 2005).Between 1996 and 2006, Heijink et al. (2013) found a statistically significant correlation between healthcare spending and preventable mortality in 14 western nations. In nations where healthcare spending increased by 1.9 to 5.9% annually, mortality decreased by 2.6 to 5.3%.According to James W. Shaw, William C. Horrace, and Ronald J. Vogel (2005), doubling annual pharmaceutical spending increased life expectancy by roughly one year for men at age 40 and by less than a year for women at age 65..Salehi et al. (2022) examined statistics on the average lifespan of children born in Iran and across Asia from the years 1960 to 2020. The life expectancy in Asia (which includes Iran) was significantly lower than in the rest of the world.In 2016, Hauck K, Martin S, and Smith PC studied the data of 54 low-income nations using 45 indicators for the period 1990–2012. Gender equality, increased agricultural output, political stability, sanitation, effective leadership, primary school enrollment were all contributors to a longer life expectancy.

Lei H et al.(2009) explored the socioeconomic factors associated with life expectancy in Beijing. The results based on linear stepwise regression model identified floor space available per rural resident, GDP per capita, the proportion of rural population to be positively associated with life expectancy and illiteracy rate to be negatively correlated with life expectancy.

There are still gaps in understanding how emerging factors, such as environmental sustainability, the impact of health interventions influence life expectancy. Very few studies have been conducted for Asia. Filling these gaps will help policymakers design more effective public health interventions and contribute to the global effort to improve health outcomes in diverse settings.

3. OBJECTIVES OF STUDY

- This study aims to investigate the determinants of life expectancy in 18 Asian low-middle countries using the World Bank data over the period of 17 years (2005–2021).
- To develop a regression model that will provide coefficients to evaluate the significance and impact of different independent variables on the life expectancy.

4. RESEARCH METHODOLOGY

1) Scope and period of Study

The factors that affect life expectancy in Asian nations have been the subject of scant academic investigation. The present study has studied the parameters of Low-middle income countries of Asia. Bangladesh, Bhutan, India, Combodia, Srilanka, Iran, Myanmar, Mangolia, Kyrgyz Republic, LAO PDR, Philippines. Pakistan, Timor Leste, Vietnam, Indonesia, Tajikistan, Lebanan and Nepal have been included in the study. The categorization of the countries is based of World Bank Group classification of countries on the basis of income. The period of the study was 2005-2021.

2) Selection of variables

The literature analysis revealed seventeen factors that might influence longevity. The life expectancy at birth served as the study's dependent variable.The analysis relies on data collected from the World Bank Data.

- Mortality from Cardiovascular diseases (CVD), cancer, diabetes or Chronic respiratory disease (CRD)

  If a baby doesn't develop normally in the first year, it raises their biochemical risk of cardiovascular disease in adulthood (Barker et al., 1992) and their risk of hypertension in adulthood (Barker 1994).

- Infant mortality rate

The annual number of infant deaths has dropped from 8.7 million to 2.3 million between 1990 and 2022. (WHO Report). Kim, T. K., and Lane, S. R. (2013) compared 17 OECD nations. Using a mixed-effects model, it was determined that government health spending had a positive correlation with life expectancy and a negative correlation with the infant mortality rate.

3) Fertility rate per 1000 female

Md. Nazrul Islam Mondal, Mahendran Shitan (2013) investigated the variables for low- and middle-income nations. Total fertility rate, adolescent fertility rate, mean years of schooling, gross national income per capita, physician density were the determining factors in the path analysis.

Current health expenditure per capita

Between 2000 and 2018, researchers Bunyaminu et al. (2022) used GMM estimation approach studied at 43 African nations and showed that life expectancy was positively impacted by health expenditure, school enrollment, and economic activity level.

4) The percentage of domestic general government health expenditures Present-day Health Spending (CHE)

In their study, Rosa et al. (2014) utilized cross-country fixed effects multiple regression analysis and found that spending on public health has a substantial impact on improving longevity. Similar results were obtained in a study by Effiong, Ubong, and Bassey, Godwin (2020) for Nigeria from 1981 to 2018 using Autoregressive Distributed Lag (ARDL) model.

5) Level of Employment

According to research on joblessness and insecurity, having no steady income can have negative effects on one's health (Bartley 1994).. Theorell (1992) found that being unemployed is linked to low psychological well-being and a negative view of oneself.

6) Level of Literacy

People from lower socioeconomic backgrounds who work in physically demanding jobs are more likely to smoke and less likely to respond quickly to health concerns. (Graham 1984); Income in adulthood is negatively correlated with level of education. (Kuh and Wadsworth 1991), due to the decreased availability of nutritious food and the resulting short lifespan.

7) GDP per Capita

Life expectancy is unaffected by further advances in living conditions after a country's revenue reaches a particular level. (Richard Wilkinson 1996). As per the study conducted by He, L., Li, in 2009, the correlation between GDP per capita (or total GDP) and life expectancy is positively significant over the long term. Similar results were also obtained by (Bhargava et al., 2001; Sunde & Vischer, 2015). Ruby et al. (2021) used a Multiple Linear Regression model to find a robust relationship between Bangladesh's GDP and life expectancy.

8) CO2 emissions(kt)

It is anticipated that CO2 emissions would have a negative correlation with longevity. Mantu Kumar Mahaliket al(2022).J.I. Amuka et al.(2018)concluded, however, that CO2 emissions have not shortened the average lifespan in Nigeria.

9) Physicians and Nurses per thousand

PA Martín Cervantes et al(2019) focused the study on 17 different regions in Spain from 2006–2016 and the results showed that higher life expectancy is caused by per capita income, the proportion of nurses, doctors, and hospital beds,

according to the Granger causality test applied to panel data. Another study by Paolo Roffia, Alessandro Bucciol & Sara Hashlamoun (2022) based on data collected from 36 OECD member states between 1999 and 2018 validated that health care spending are relevant to determining a nation's average life expectancy.

10) Urbanisation

Fayissa et al.(2005) in his paper constructed a health production function for Sub-Saharan Africa using the theoretical model proposed by Grossman (1972). The two-way random effect

model's findings corroborated the significant link between increased life expectancy at birth and factors such as urbanization, greater literacy rates, food security, and per capita income.

11) Out of pocket expenses

Baltagi et al (2012) investigated the determinants of life expectancy across OECD by using data on life expectancy at age 65 over the period 1960 to 2007. Health, social expenditure, lifestyle variables and medical innovation were found to be important variables.

12) Consumer price index

Laurence L. Garcia (2019) discovered a negative correlation between inflation and life expectancy using binary logistic regression; a 2% increase in inflation results in a 20% decrease in life expectancy.

13) Size of population

The size of a population is often taken as a surrogate for its overall health.

5. RESULTS

Absence of multi-collinearity, absence of autocorrelation(serial correlation), linearity, normality and homoscedasticity. Assumptions were satisfied before executing Ordinary Least Square (OLS) linear regression model. E views 12 was used to conduct Normality test . As the p value was .27, the Jarque–Bera goodness-of-fit test validated normality. (annexure, table 1) Test for Auto correlation and Multicollinearity was conducted. In order to detect autocorrelation, Durbin-Watson stat value was studied in the summary table obtained after applying OLS estimator. The value confirmed auto correlation. (annexure,table 2). To test the multicolinearity, Variance inflation factors test was applied in E-views, and all of the variables whose Variance inflation factor values were less than 10 were taken. The selection of the variables confirmed low or nonexistent multicollinearity among the variables except current health expenditure, co2 emissions, population and out of pocket expenses. (annexure, table 3). To check Homoscedasticity, Heteroscedasticity test was conducted in e views. It was concluded that heteroscedasticity is present in panel not in period. (annexure, table 4 &5). Test of goodness of fit of model (wald coefficient diagnostic test) was performed using e-views and all the variables were found to be significant. (annexure, table 6). Cross section dependence of data was checked using the LM test developed by Breusch and Pagan (1980), as well as the CD and scaled LM tests developed by Pesaran (2004), the panel data was examined for cross-sectional dependence.

Table 1 Cross section dependence test

Table 1 Cross section dependence test			
Test	Statistic	d.f	Probability
Breush- Pagan LM	440.6197	153	0.00
Pesaran scaled LM	16.44213		0.00
Pesaran CD	6.262842		0.00

The test results verified that cross section dependence was present as p<.05 for all the tests.

For checking the stationarity, Second generation unit root tests were used as first generation tests are not robust if there is cross section dependence in panel data set. The variables literacy level, age dependency, mortality from CVD, cancer, diabetes or CRD, level of urbanisation and employment to population ratio were stationary at level whereas all other variables were stationary on the first difference .(annexure, table 7)

6. THE MODEL

The results that were mentioned earlier proved that there was normalcy and no multicolinearity. Panel data did, however, exhibit autocorrelation, heteroscedasticity, and cross-sectional dependence. To construct the model, the PCSE method was employed. When dealing with errors that are prone to autocorrelation, the PCSE approach employs an estimation based on the variance-covariance matrix. Panel heteroscedasticity is also successfully addressed by the PCSE approach. Because errors of one country often have correlations with errors of other countries, the error variance and correlations between errors can vary from one country to the next (Beck and Katz 1995). Inconsistent OLS standard errors are a result of cross-section heteroscedasticity. Although OLS can calculate standard errors that are consistent with heteroscedasticity, it will ignore the panel structure of the errors when doing so. For panel data, the PCSE formula was developed. PCSE takes an average across units after estimating the variance-covariance matrix independently for each unit. This takes into consideration the correlations in the mistakes both within and across units. When the homoskedasticity and absence of serial correlation requirements are not met, the GLS estimator turns blue. According to Tabοτa (2021). We used the FGLS model for our robustness checks. The FGLS method employs a weighted least squares strategy, which involves assigning each observation a weight according to its expected variance. When dealing autocorrelation, the generalized least squares method is employed. We utilize a first-order autoregressive process that presupposes a correlation between the current error and a prior error with a given lag.

THE PCSE and FGLS method were used and the following results were obtained. The coefficients obtained through applying PCSE method are given below.

Table 2 Panel Corrected Standard Model and FGLS method:Robustness check Results

Table 2:Panel Corrected Standard Model and FGLS method:Robustness check Results				
PCSE Model			**FGLS method:Robustness check**	
chi2 = 0.0000			Wald chi2(13) = 1164.41	
R-squared = 0.9999 Wald chi2(13) = 936.48 Prob >			Prob > chi2 = 0.0000	
ln_ life expectancy	Coeeficients based on PCSE model			P>|z|
		P>|z|	Coefficients	
ln_nurses per thousand			0.000282	
	-0.0043824		-0.43	
	(-3.05)	0.002***		
				0.664
ln_physcians	0.0032128	.021**	0.001372	
	-2.3		-1.12	0.265
ln_domestic general government health exp.	0.0101553		0.000049	
	-2.04	.041**		
				0.886
ln_mortality	-0.0362699	0.000***	-0.02643**	
	(-3.53)		(-3.1)	0.002**
ln_infant mortality rate	| -.0847543	0.000***	-0.0729***	
	(-13.30)		(-15.34)	0.000***
ln_fertility	0.0316198	0.000***	-0.02302***	0.000***
	-3.6		(-4.36)	
ln_age dependency	-0.0009833	0.624	-0.00178	
	(-.49)		(-1.36)	0.1*
ln_consumer price index	-0.0079458	.103*	-0.00605*	
	(-1.63)		(-1.81)	0.07*
ln_employment to population	-0.0158727	0.05**	0.002519	
ratio	(-1.90)		-0.55	0.583
ln_Gross domestic product	0.0067907	0.065*	0.006427***	

	-1.85		-2.57	0.01***
ln_literacy rate	-0.0043053	0.04**	-0.00025	
	(-2.00)		(-0.18)	0.859
ln_urban population	0.0058907	0.326	0.008939	
	-0.98		-1.4	0.1*
ln_ope as % of current health	0.0087503	.01***	0.001123	
expenditure	-2.44		-0.49	0.623
_cons	1.992548	0.000***	1.971503	
			-93.95	0.000***

*shows significance at 10% ** shows significance at 5% *** shows significance at 1%

The regression outputs based on PCSE are shown in table 2. Life expectancy was the dependent variable and 13 independent variables were undertaken. Mortality from CVD, cancer, diabetes or CRD, Infant Mortality rate, employment to population ratio, consumer price index, literacy rate, nurses per thousand population and age dependency were negatively associated with life expectancy. Mortality from CVD, cancer, diabetes or CRD and Infant Mortality rate were found to be significant at 1% level of significance as they all have p values less than 0.01. Employment to population ratio, literacy rate and nurses per thousand populations were significant at 5% level of significance with p value of less than .05. Consumer price index was significant at 10% level of significance. Age dependency had negative but insignificant association with life expectancy as p value was .624.

Domestic General Government Health Expenditure as % Current Health Expenditure, fertility rate, GDP per capita (current US $), Physicians per thousand population, out of pocket expenses as percentage of current health expenditure and urban population (% of total population) had a positive effect on life expectancy. Domestic General Government Health Expenditure as %

Current Health Expenditure, physicians per thousand were significant at 5%. Out of pocket expenses and fertility rate were significant at1% . GDP per capita was significant at 10%. Urban population (% of total population) was insignificant as p value was .326.Based on the above results. Following model was developed based on PCSE model. Compared to FGLS, the PCSE estimator offers precise standard error estimation with minimal efficiency loss.

ln_leit=2.017+.0036lndggheit -.028lnmorit-.085lnimrit+.026lnfeit-.0119lncpiit-

.017lnempit+.0068lngdpit+.004lnlrit+.0025lnphyit+.0063lnurbanit+it

All things considered, the FGLS results show noteworthy and consistent findings with PCSE estimates.

7. DISCUSSION

To determine the effect of particular variables on life expectancy, the study used the cross-sectional dependence test along with other essential diagnostic techniques for panel data. Statistically significant results were confirmed by the outcomes of the FGLS (Feasible Generalized Least Squares) and PCSE (Panel Corrected Standard Errors) regressions.Infant mortality rate, the rates of cardiovascular disease, cancer, diabetes, and chronic renal disease (CRD), consumer price index, literacy rate, nurses per thousand, age dependency ratio and percentage of population employed have negative effect on life expectancy. A 1% rise in the mortality rate will shorten life expectancy by 3.62%. The life expectancy would be 8.47% shorter for every 1% rise in the newborn mortality rate. A rising cost of living drastically shortens the average lifespan of a country's citizens. A 1% increase in inflation is linked to a.79% decrease in life expectancy.The three factors taken together turn out be the primary determinants of life expectancy in low-middle income countries of Asia.

The study found that 1% increase in employment to population ratio will reduce the life expectancy by 1.5% .This finding is in line with Hauck K, Martin S, and Smith PC(2016) who found urbanization, environmental degradation and employment did not have an impact on people's well-being. The coefficient of both literacy rate and nurses per thousand was found to be -.004. In general, those who have completed more years of formal education tend to be more health conscious and to take greater measures to maintain or improve their overall well-being. Life expectancy decreased by.4 percentage points for every 1 percentage point rise in literacy, according to the study. This variable did not have a

significant impact. The variable nurses per thousand shows a negative relation with life expectancy. The variable age dependency ratio although negatively related with life expectancy was found to be insignificant.

Fertility rate, GDP per capita, physicians per thousand, out-of-pocket costs and health care spending were positively affecting the life expectancy. 3.16% rise in life expectancy is possible with a 1 percentage rise in the fertility rate. An increase of 0.32% in life expectancy is associated with a rise in the total number of physicians per thousand. The results coincide with the findings of Gilligan AM and Skrepnek GH. A country's GDP per capita increases as its economy expands and grows, raising the life expectancy at birth. Life expectancy will grow by 0.68 percentage points for every 1 percent rise in GDP per capita. The life expectancy will be increased by.87% and 1.01%, respectively, by out-of-pocket costs and health care spending . Increased expenses for healthcare has a notable and favorable effect on life expectancy, indicating that more healthcare spending would lead to an increase in life expectancy. This result is consistent with previous studies that indicate healthcare spending has a major impact on life expectancy (Cremieux et al., 1999, 2005; Heijink et al., 2013).

8. CONCLUSION

A number of policy suggestions based on the results are provided. 18 low-middle income countries of Asia were the focus of this research. The variables influencing life expectancy were estimated using state-of-the-art econometric techniques. The leading cause of shortened life expectancy is the infant mortality rate, which is followed by mortality from diabetes, cancer, heart disease, and chronic respiratory conditions. Establishing facilities for the treatment of ill newborns, enhancing the ability of healthcare professionals by educating physicians, nurses, and others in the early detection and treatment of common pediatric illnesses, and providing care for mothers during pregnancy and delivery, management of malnutrition and Universal Immunization Programme can lead to reduction in infant mortality rates.To reduce the chance of dying from cardio vascular diseases, cancer, diabetes and chronic respiratory diseases , health promotion activities for life-style changes should be promoted. Increased preventative measures which stress on primary prevention and early detection of cancer and diabetes need to be initiated even at the level of villages and small towns. Employment to population ratio, consumer price index were negatively associated with life expectancy. Certain variables, such as GDP per capita, literacy rate and increased availability of physicians are undoubtedly important for increasing life expectancy. Underdeveloped countries by ensuring enhanced education and medical facilities can achieve longer life expectancy over time. Life expectancy has been found to be positively impacted by domestic general government health spending. Therefore, by making relatively small increases in healthcare spending, lower-income nations with low initial spending can significantly increase life expectancy. The governments should enhance the allocation of funds within the budget for healthcare spending. The study has a few constraints that could be resolved in a subsequent analysis. Initially, the approximated model did not incorporate critical variables that influence life expectancy, including malnutrition, lifestyles habits, capital expenditure on health, inequality in access to safe drinking water, sanitation, and income due to the lack of data for the chosen time period. The negative impacts of these factors on life expectancy require further investigation and understanding.

CONFLICT OF INTERESTS

None.

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