ORIGINAL ARTICLE

Does universal health insurance act as a driver of increased life expectancy? Evidence from selected emerging economies

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Abstract

Background: The world currently has experienced an unimaginable increase in life expectancy rate (LER). There are many factors that influence LER, including faith and forgiveness. However, an ongoing argument among scholars is whether health insurance is partly ascribed to the historical forces that drive the surge in LER among emerging countries. The study seeks to investigate the long-run effect of universal health insurance (UHI) on LER among 15 selected emerging countries spanning from 2000 to 2015.

Methods: Using the panel unit root, panel cointegration, panel fully modified least squares (FMOLS), and employing the Dynamic ordinary least square (DOLS) as a robust check, the study analyzed connections between the study variables.

Results: The outcome of the results showed that UHI, physician ratio, healthcare expenditure, and educational factors are positive contributors to increasing life expectancy, while economic growth remained negatively significant in the selected emerging economies.

Conclusion: This study showed that improved education, increased physician ratio, increasing health expenditures, and universal insurance coverage were correlated with increased life expectancy in emerging economies. In order to promote healthy lives of its citizens, a move toward UHI coverage is suggested since it increases the life expectancy rate among emerging nations.

Key words: Universal health insurance, life expectancy, emerging countries, fully modified least squares

Introduction

A healthy body with a sound state of mind supports a successful life. According to Deaton, it is difficult for billionaires to enjoy life to the fullest without good health.[1] While all workers need a healthy life in order to actively function, a healthy life offers children a sound academic life that enables active participation in many other activities both at school and home.[2] Nevertheless,

some developing nations fail to offer their citizens an ideal opportunity for healthy living. Emerging nations are those countries that invest in industrial capacity for production. They are moving away from an economy that depends on the export of raw materials and on agricultural activities.

In many emerging countries, health financing is characterized by high out-of-pocket (OOP) spending for health care. People who are not able to afford health care avoid visits to health facilities and delay or postpone seeking medical attention.[3] Consequently, the World Health Organization (WHO) embraces policies that mobilize more resources for health and enhance attainment of quality health care delivery, particularly among low income countries.[4] These policies are reinforced by the World Bank as a technique to achieve universal health coverage.[5]

The world is currently experiencing an increase in life expectancy rate (LER). However, an ongoing discourse among scholars, technocrats, and policy makers is whether health insurance is partly ascribed to the historical forces that drive the increase in LER among emerging countries. Jakovljevic *et al.* noted that the speedy increase in life expectancy echoes the overall influence of an operational healthcare system and policies within a country.[8]

Some researchers, such as Deaton and Xiong *et al.*,[9] tend to concentrate on health insurance and accessibility of health care universal capital while Duku *et al.*[10] and Yang[11] focus on perception and quality of universal health insurance (UHI). Wilper *et al.*[12] explore the effects of health insurance on mortality rate in the United States using a survey and concluded a negative association between health insurance and death rate. A study by Anderson *et al.*[13] also established that health insurance helps promote protection for financial risk, equal access, and equity in health financing among the Taiwanese.

Anderson *et.al.*,[13] in a survey, examined the influence of health insurance coverage on the utilization of Medicare service and concluded that expanding insurance for healthcare will lead to a substantial surge in care provided to new uninsured members. Employing a regional census and cancer registry data for 1987–1993, Lee-Feldstein *et al.*[14] examined relationships between diagnosis, survival experience, and treatment and health insurance among breast cancer patients. They established that health insurance will lead to the utilization of health services. Ekman reviewed articles on the impacts of community-based health insurance on the mobilization of resources and providing financial protection among the low-income countries.[15] The author discovered that health insurance provides some financial protection by reducing OOP spending. Kilbourne,[16] examining the impact of health insurance on population health, deduced a positive connection between health insurance and health-related outcomes. Another line of study explored the effect of health insurance on the usage of mammography among cancer patients, but failed to establish a positive effect for insurance coverage.[17]

Several independent variables, such as governance, accessibility to safe water, OOP payments, urbanization, nutritional outcomes, and geographical status, have been established to significantly affect life expectancy.[18, 19, 20] Others confirmed that adult and infant mortality, socio-economic status, disease control interventions, and life style were related to longevity.[21,23]

Toussaint *et.al.*[6] examined multiple types of forgiveness as predictors of mortality and potential psychosocial, spiritual, and health mechanisms of the effects of forgiveness on longevity. Data from a nationally representative sample of United States' adults ages 66 and older measured forgiveness, health, religiousness/spirituality, and socio-demographics. The study reports reduced mortality with understanding God's unconditional forgiveness and increased mortality with conditional forgiveness toward others. Several scriptures from the Holy Bible (Psalm. 91:16; Job 5:26, 42:17; Proverb 3:2; Zechariah 8:4; Isaiah 65:22; 1 Peter 3:10) also consider longevity as a sign of righteousness/justice and God's blessings.

McCullough *et al.*[7] examined the relationship between devoutness and longevity. Psychological

investment in religion was associated with the delay of death in the Terman sample. Survival differences were largely attributable to cross-sectional and prospective between-class differences in personality traits, social ties, health behaviors, and mental and physical health.

In contrast to existing analyses of these other factors for life expectancy, only a few studies examined the long term role of UHI on health outcomes among 183 emerging nations,[24] Nepal,[23] and the United States.[25] Though attaining universal health coverage is a target of the Sustainable Development Goals (SDGs), no study focused on the role of UHI on life expectancy in emerging nations.[26] In the existence of such a knowledge gap, this study focuses on a panel of thirteen selected emerging countries.

Previous studies have concentrated on cross sectional survey and times series analysis. This study is novel as it uses a panel data set, allowing comparisons to be made across countries and regions, especially where the emerging countries are the fastest growing nations, and also serve as mentors for other developing nations.[27] Again, the present study attempts to identify a causal association between UHI and life expectancy, and this will provide new discussion on financial pressures and the potential for health reform. Furthermore, the employment of cross-sectional dependence (CD) and homogeneity tests allows appropriate econometrics methods that avoid spurious results. Finally, panel fully modified least squares (FMOLS) and dynamic ordinary least square (DOLS) analyses are employed to estimate the long run relationship between the variables as these methods provide efficient results in the presence of endogeneity.

Figure 1. Time series pattern of universal health insurance among emerging countries 2000–2015

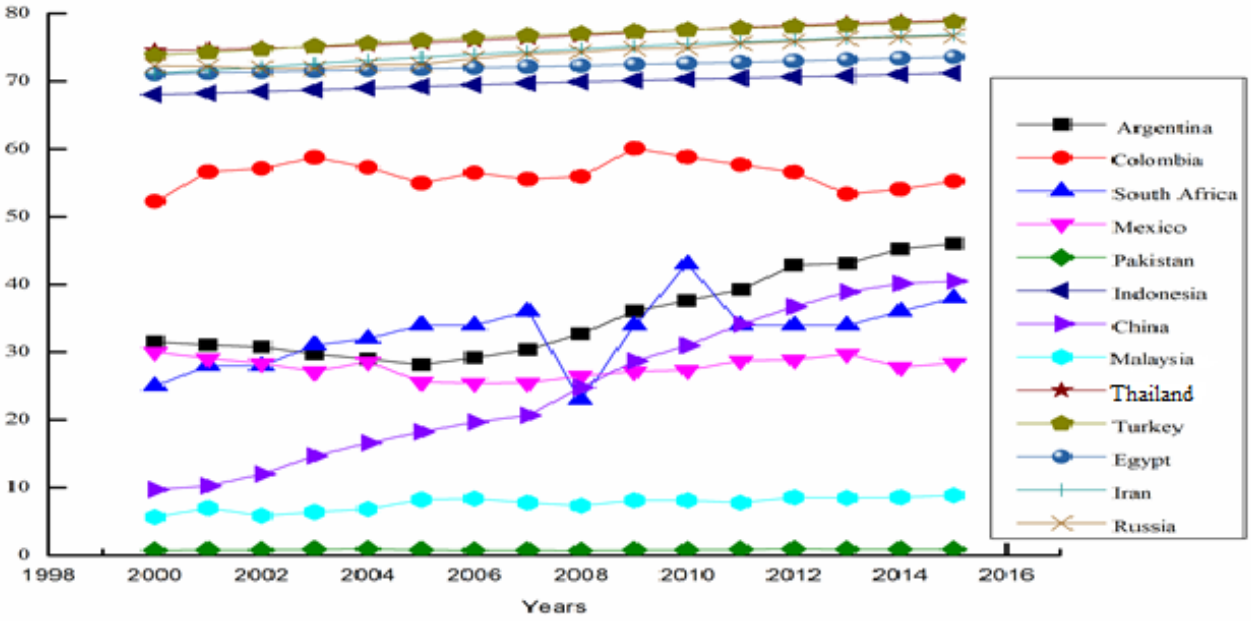

Figure 1 shows universal health insurance coverage among 13 emerging countries between 2000 and 2015. The percent (%) of current health expenditure offering quality health care to all citizens is plotted over time. There has been gradual increase among a number of countries, with Turkey leading the group while Pakistan and Malaysia performed poorly.

Figure 2. Annual health care expenditures US$ (2010)

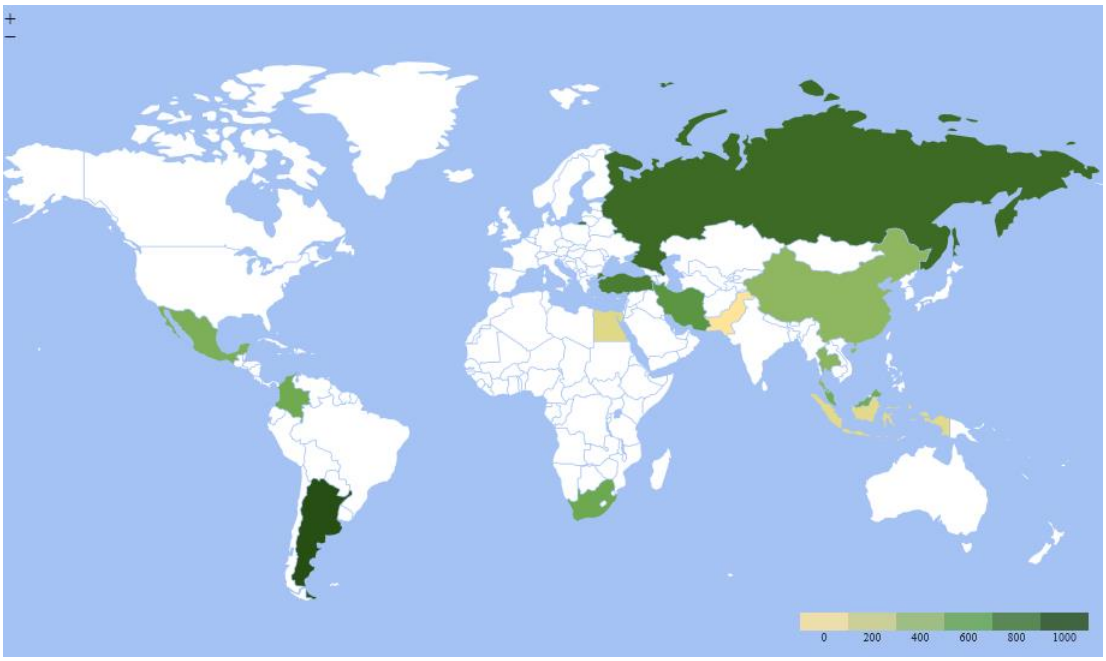

Figure 2 offers a comparison between emerging countries in their efforts to promote quality health care. During 2015, Argentina had the highest rate of public health cost as compared to Russia, South Africa, Indonesia, Thailand, Iran, Columbia, Mexico, China, Turkey, Malaysia, Egypt, and Pakistan.

Figure 3. Life expectancy rates over time among emerging countries 2000–2015

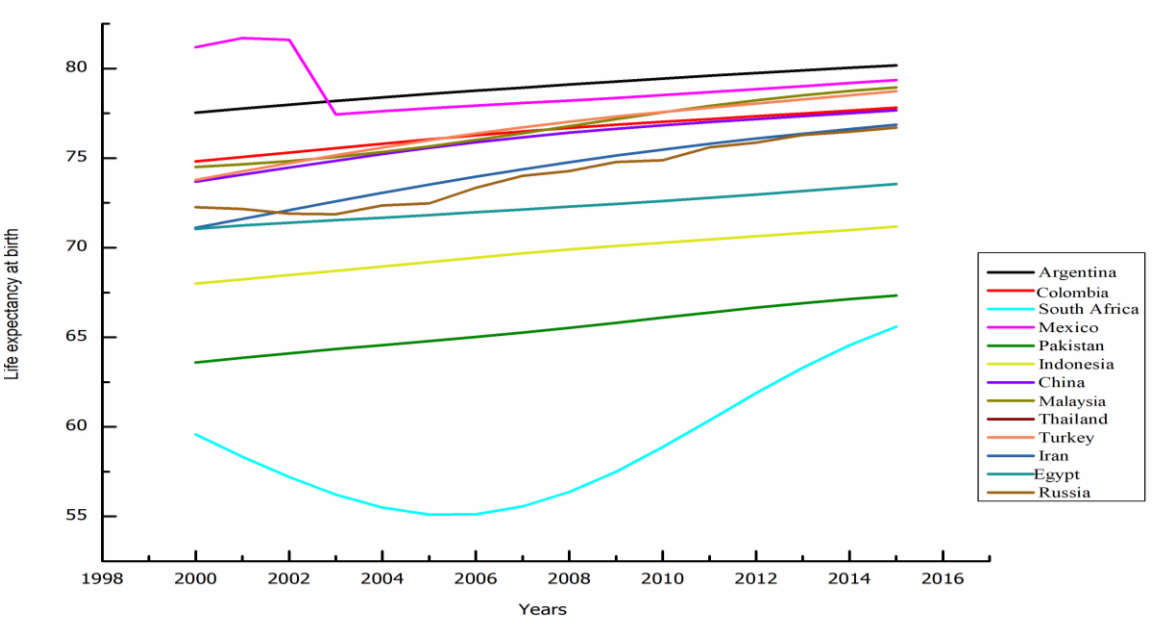

Figure 3 shows life expectancy is measured as the average number of years remaining for an individual at any given age centered on the year of birth. Argentina stands out as the star performer with South Africa being the worst among the group.

Materials and Methods

Data

The study extracted data from the World development indicators[28,29] and the Global Health Observatory data[30] covering the period 2000 to 2015 because data are only available within these periods. We studied the association between UHI, life expectancy, health care expenses, number of physicians to population ratio, literacy rate, and economic growth from the thirteen selected countries to explore individual effects of UHI among emerging economies. Table 1 describes the variables studied, their abbreviations, the unit of the variable used, and the sources of the variable data.

Table 1. Name and definition of variables

Abbreviation	Variable name	Unit	Source
LER	Life expectancy	Age-at-death	World Development indicator (2015)
UHI	Universal health insurance	% of current health expenditure	Global Health Expenditure database (2015)
Phy	Number of physicians	Physician per unit of population	World Development indicator (2015)
GDPc	Gross domestic product per capita %	Current US $	World Development indicator (2015)
LITR	Literacy rate	% of the population aged 15 years and over who have completed high school	Barro and Lee (2015)
HCE	Current health care expenditures per capita in PPP international dollars	Constant 2010 US$	World Development indicator (2015)

Source: World Development indicator (2015), UNICEF (2015), & Barro and Lee (2015)

Supplementary Table 1 shows the mean, minimum, skewness, standard deviation, kurtosis, and Jarque-Bera test of the variables. Life expectancy has the highest mean whilst physician ratio had the lowest mean value indicating life expectancy as a critical variable in emerging economies. Universal health insurance has the highest standard deviation. The distribution of physician data displays a positive value for excess kurtosis, called leptokurtic, which indicates a sharp peak in the distribution. The Jarque-Bera test (the difference between the kurtosis and skewness of each variable) shows a normal distribution for all variables.

Supplementary Table 1. Descriptive analysis

	LER	LIT	PHY	UHI	HCE	GDPC
Mean	73.95367	27.22165	1.807018	23.87273	5.510032	12.30082
Median	75.64550	24.85000	1.235000	25.19484	5.790293	10.92078
Maximum	81.73600	61.40000	42.00000	60.09808	7.053359	18.25497
Minimum	55.09700	10.40000	0.014000	0.558896	2.931237	9.181529

Std. Dev.	5.869973	9.792527	3.528317	17.68763	0.965980	3.006685
Skewness	-1.402444	0.985828	9.252645	0.288523	-0.983915	0.750643
Kurtosis	4.690461	4.138422	97.57425	1.957425	3.237716	2.013499
Jarque-Bera	100.1005	48.37870	86676.19	13.25282	36.66938	30.11911
Probability	0.000000	0.000000	0.000000	0.001325	0.000000	0.000000
Sum	16565.62	6097.650	404.7720	5347.491	1234.247	2755.383
Sum Sq. Dev.	7683.819	21384.27	2776.131	69766.01	208.0851	2015.955

Model specification

The study is grounded on "demand for health" proposed by Grossman,[31] where health is regarded by the individual as a necessary product and other factors, such as income and education, from which happiness is gained. According to the production function of health, citizens and states become healthy by consuming health care services. To analyze the impact of UHI on life expectancy, the study begins with a panel model expressed as:

$$(1) \qquad Y_{it} = \alpha_i + \varphi_1 X_{it} + v_{it}$$

where Y is the dependent variable (LER), X is the independent variable, φ the vector coefficients of independent variables, α_i the intercept which represents the country, and v signifies the error term.

In limiting the equation to the study objective, we formulate equation 2:

$$(2) \qquad LER_{it} = \alpha_{it} + \varphi_{1_1} UHI_{it} + \varphi_2 HCE_{it} + \varphi_3 GDP/cap_{it} + \varphi_4 LITR_{it} + \varphi_5 PHY_{it} + v_{it}$$

where LER represents expectancy rate, *LITR* represents literacy rate, *HCE* stands for healthcare expenditure, α the intercept which represents the country, φ the vector coefficients, *HLTEXP* denotes public health care expenses, *PHY* is the number of physician per population, *UHI* is universal health insurance, $GDPc$ is the GDP per capita, and v is the error term.

Econometric method

Employing panel data in empirical studies has merits and demerits. One major advantage of a panel study is spatial dependence, that is, the propensity for variables to influence each other and to possess similar attributes and heterogeneity. Recent literature on the influence of health insurance on health status using panel data analysis employed first-generation econometric technique. The first-generation econometric technique assumes cross-sectional independence and homogeneity in the panel data sets. However, such an assumption could lead to spurious results in cases where the data are cross-sectionally dependent and heterogeneous. However, if second generation econometric procedure is used, weaknesses related to panel data are considered and adjusted. The study, therefore, proceeded with the preliminary test

Preliminary Results

A preliminary test of the data for cross sectional dependence, homogeneity, panel unit root, and cointegration was undertaken.

Cross-sectional dependence and homogeneity test

Before testing for integration (unit root) among the study variables, a CD) test was performed. This will provide the basis for the selection of subsequent econometric tests.

Table 2 shows test results for CD. The null hypothesis was not supported at the 1% significance level indicating that cross-sections were not independent. The homogeneity test

assessed uniformity of the cross sections using adjusted delta tilde tests, according to Pesaran and Yamagata. [32] The null statement of homogeneity was rejected at a 5% significance level, an indication that, the coefficients are heterogeneous. This enabled the researchers to select the appropriate unit root methods and estimation techniques for the study.

Table 2. Cross- sectional dependence and homogeneity test results

Cross- sectional dependence test (null hypothesis: there is cross sectional independence)		
	CD-test[c]	Variable
*ln*LER	29.14735	(0.0000)
*ln*HCE	78.07571	(0.0000)
lnLITR	4.890231	(0.0000)
*ln*GDPC	9.441241	(0.0000)
*ln*UHI	6.984736	(0.0000)
*ln*PHY	9.441241	(0.0000)
Homogeneity test results		
Test	Statistic	p-value
Delta_tilde	163	(0.0000)*[b]
Delta_tilde adj	5.722	(0.0000)*

Notes. [a]*P*-values are in parenthesis. [b]*represents 1% significance level. [c]CD-test denotes cross-section dependence test.

Panel CADF and CIPS unit root tests

Subsequent to testing for homogeneity, we conducted cross-section augmented Dickey-Fuller (CADF) and cross-section augmented IPS (CIPS) tests by Pesaran,[33] as shown in Table 3. The previous test results for cross-sectional and homogeneity require utilization of the second-generation techniques to produce robust results. Thus, the use of the traditional unit root technique could lead to invalid results. The selection of CADF and CIPS unit root tests obviate this risk. The CADF and CIPS test results show reliable and effective cross-dependence and heterogeneity between the countries studied. The findings confirm that there is non-stationarity with the data at levels. However, they became stationary at their first difference; thus, the data are considered stable during the lag one period. The null hypothesis is rejected because there was stability among the series.

Table 3. Unit root test and results

	CADF		CIPS	
Variable	At level	At 1st difference	At level	At 1st difference
lnLER		[-3.828]***	[-2.488]	[-3.255]***
lnUHI	[-1.439]	[-3.006]***	[-1.414]	[-3.006]***
lnGDPC	[-2.142]	[-3.542]***	[-2.572]	[-2.84]***
lnHCE	[-1.978]	[-2.975]***	[-2.65]	[-4.174]***
lnLITR	[-1.179]	[-2.351]**	[-1.768]	[-3.777]**
lnPHY	[-2.096]	[-1.870]**	[-1.527]	[-4.415]**

Notes. ** and *** designate statistically significant at 5% and 1%, respectively, while figures in brackets signify and t–statistics of variables respectively.

Cointegration test

Table 4 gives the results of the Kao[34] and Pedroni[35] cointegration tests. The null hypothesis of no cointegration is rejected at the 5% significance level.

Table 4. Panel cointegration test results

Cointegration test		
Kao cointegration test		
	t-Statistics	Prob.
ADF-statistics	-2.80079	0.0025*
Pedroni Residual Cointegration Test Common AR coefficients (within – dimensions)		
	Statistic	Prob.
Panel v-Statistic	-0.145	(0.000) *
Panel rho-Statistic	2.325	(0.990)
Panel PP-Statistic	-4.491	(0.000) *
Panel ADF-Statistic	-4.702	(0.000) *
Individual AR coefficients	Statistic	Prob.
Group rho-Statistic	4.490	(0.885)
Group PP-Statistic	-0.913	(0.041) *
Group ADF-Statistic	-1.940	(0.026) *

Note. *designates statistically significant at 5%, while the figures in parenthesis denote probability values

Results from panel FMOLS and DOLS analysis

The FMOLS and the DOLS techniques were employed to determine the long-term relationship between the panel data. The results are shown in Table 5. UHI and LER are significantly and positively related. A unit increase in UHI (% of current health expenditure) will increase life expectancy by 1.478% and 0.028% (FMOLS, DOLS respectively)

in the studied countries, as indicated. In addition, the coefficient from the FMOLS and

DOLS assessment of government HCE is positive and significant.

As the per capita income of these emerging countries have increased in recent years, so has the government expenditure on health. Economic growth is significantly negative in the FMOLS analysis. Using the DOLS analysis as a robust check on this result reveals a positive relationship. A unit increase in economic growth will reduce life expectancy at birth by 0.5%.

The physician to population ratio was also positive in the FMOLS estimation procedures. An estimated 1% increase in physician to population ratio will result in an increase in life expectancy of 1.021%. Inversely, the findings of the DOLS coefficient established a negative relationship between physician to population ratio and life expectancy. The literacy rate in this study has a positive relationship with life expectancy. Coefficients from both FMOLS and DOLS estimations indicate that a unit increase in literacy will lead to an increase in life expectancy of 0.066 and 0.003 years, respectively, in the emerging economies.

Table 5. Panel FMOLS and Panel DOLS results for emerging countries

(a) Panel FMOLS results			**(b) Panel DOLS results**		
Variable	Coefficient	t-Stat	Variable	Coefficient	t-Stat
*ln*UHI	0.308***	22.971	*ln*UHI	0.009***	37.382
*ln*HCE	1.478***	5.331	*ln*HCE	0.028***	4.129
*ln*GDPC	-1.572**	-2.429	*ln*GDPC	0.002**	2.023
*ln*PHY	1.021**	3.317	*ln*PHY	-0.005*	-1.781
*ln*LITER	0.066***	8.735	*ln*LITE	0.003***	13.749
R^2	0.673		R^2	0.913	
Adj R^2	0.703		Adj R^2	0.970	

Note. ***, **, * designate significance level of 1%, 5%, and 10%, respectively.

Granger causality test

For an in-depth understanding of the direction of the association between public health costs and its determinants, the study used the Dumitrescu and Hurlin[36] Granger causality test. The results are shown in Table 6. There is a bidirectional causal relationship between life expectancy and economic growth, health care expenditure and life expectancy, education and life expectancy, literacy rate and economic growth, UHI and economic growth, and UHI and health care expenditure. Unidirectional causality was found between UHI and LER, physician to population ratio and literacy rate, and UHI and physician to population ratio. Again, the Dumitrescu-Hurlin Granger causality test also revealed an independent causal relationship between literacy rate and health care expenditure.

Table 6. Dumitrescu-Hurlin Granger causality test

Hypothesis:	Prob.	Conclusion
GDPC does not homogeneously cause LE	0.000**	Bidirectional causality between GDPC and LE
	0.000**	
HCE does not homogeneously cause LE	*	Bidirectional causality between HCE and LE
	0.000**	
LITER does not homogeneously cause LE	*	Bidirectional causality between LITER and LE
	0.000**	
PHY does not homogeneously cause LE	*	Bidirectional causality between PHY and LE
	0.000**	
UHI does not homogeneously cause LE	*	Bidirectional causality between UHI and LE
HCE does not homogeneously cause GDPC	0.024**	Bidirectional causality between HCE and GDPC
	0.001**	
LITER does not homogeneously cause GDPC	*	Bidirectional causality between LITER and GDPC
PHY does not homogeneously cause GDPC	0.020**	Bidirectional causality between PHY and GDPC
	0.001**	
UHI does not homogeneously cause GDPC	*	Bidirectional causality between UHI and GDPC
LITER does not homogeneously cause HCE	0.101	Independent causality
	0.000**	
UHI does not homogeneously cause HCE	*	Bidirectional causality between UHI and HCE
PHY does not homogeneously cause LITER	0.211	Unidirectional causality between PHY and LITER
	0.002**	
UHI does not homogeneously cause LITER	*	Bidirectional causality between HCE and GDPC

Note. *, **, and *** denote rejection of null hypothesis at 1%, 5%, and 1%, respectively

Discussion

Universal Health insurance

The FMOLS-estimated model suggests that UHI positively influences life expectancy in these emerging countries. One reason could be that UHI lessens the monetary cost of accessing healthcare services. It would then improve the accessibility of health resources for poor households. UHI may provide the public sector with extra resources that can be used to increase the number and quality of services for the general public. UHI gives opportunity for registered individuals to access health facilities at their time of need. It, therefore, improves access to hospital or other medical attention at the earliest stage of a disease and helps prevent complications that might result in a preventable death.

UHI also protects individuals from OOP expenses and financial burdens, thereby enhancing the utilization of healthcare services. This finding is in line with Seppehri, Sarma, and Simpson[37] study about Vietnam and Ranabhat *et al.*[23] This outcome agrees with a recent study by Woolhandler and Himmelstein[38] indicating a reduction in mortality among the insured group and shorter survival rates among the uninsured.

Health care expenditure again revealed a positive relationship with life expectancy. This suggests that the provision of medical equipment, health facilities, essential drugs, and training of health staff are crucial in achieving better health

status in these emerging countries. These findings corroborate with Farag *et al.*[39] in which outcomes from 133 lower and upper income nations support the idea that government funds for healthcare systems enhance population health.

Moreover, economic growth appears to cause a decrease in life expectancy among these emerging countries. It is likely that a low percentage of GDP is invested in disease prevention and treatment, training of health providers, and the purchase of health equipment as the economy develops. Economic growth can possibly have a negative effect on longevity through overconsumption of unhealthy food coupled with a more sedentary lifestyle with industrialization. This does not imply that the progression of the economy is insignificant, but greater attention should be paid to its potential adverse effects. The study agrees with Ang [40] in the United States. In addition, Brenner[41] and Weil[42] found economic growth associated with deteriorating health leading to untimely death. However, it opposes the findings of Gonzalez and Quast[43] who established that an increase in economic growth results in greater longevity.

Literacy

Literacy rate among the emerging nations was found to increase life expectancy. This may be because more years of schooling results in positive behavioral change and encourages a healthy lifestyle. In considering this outcome, higher educational levels may be highly correlated with overall socioeconomic status, which would be a major determinant of health status. Individuals with higher educational levels are also less likely to exhibit depression, anxiety, and stress that can lead to untimely death. Other studies on the relation between education and life expectancy have been carried out. In examining an indirect correlation between education and long life, Friedman *et al.*[44] observed that personality traits which induce one to achieve higher educational levels are connected to increased longevity. However, the causality runs in both directions because poor health will prevent the individual from pursuing education. These findings corroborate with Hahn and Truman [45] and Morrisroe *et al.*[46] The findings are not supported by Inaba,[47] whose study found no relationship between education and poor health outcome (depression) in Japan.

Physician: population Ratio

Finally, another area of the study focuses on the effect of physician ratio on life expectancy. Life expectancy is positively explained by increased physician to population ratio among these emerging nations. The implication is that a surge in the number of physicians who help patients practice healthy behaviors and avoid excessive smoking and drinking are likely to help their patients prolong their lives. Also, an increase in the number of physicians enables early detection and treatment of diseases to prevent unavoidable death. This confirms the findings of Oberg and Frank.[48] Following the empirical findings of this study, we propose that governments should intensify their support for health services because the health care indicators are mutually dependent. Increasing health care expenditure alone without improvement in other sectors will not translate into healthy life for their citizens.

Conclusion

The poor often delay and postpone seeking medical care even when they suspect signs with known symptoms of poor health in order to prevent becoming bankrupt. While political, geographical, environmental, faith, forgiveness, and other social determinants have been used in explaining the trend of longevity, our study investigated the long-term effect of UHI on life expectancy among thirteen emerging countries. Econometric procedures known to be robust and providing better statistical interpretations regarding heterogeneity and spatial dependence were deployed.

The results show that UHI, physician ratio, health care expenditure, and educational factors are positive contributors to increased life expectancy at birth in the selected emerging

economies while economic growth remained negatively significant. Education should be prioritized among emerging economies to help people change risky behaviors to healthy ones in order to improve population health and increase life expectancy. Expanding the healthcare work force is another approach that leads to increased life expectancy. The study justifies shifting away from OOP charges to UHI. This means concentrating on risk pooling and enabling financial protection from the healthy-wealthy to sick-vulnerable groups could lead to enhanced population health. This will help achieve SDG 3.2, which seeks to attain "healthy lives and promoting well-being for all in all ages." Implementing UHI on individual emerging countries is worth exploring.

Limitations

This study uses data from thirteen emerging nations whose development and other circumstances might involve conditions not seen in the world at large. Thus, the relationships between longevity and UHI found here might not apply universally. In the past, increases in life span have been connected to reductions in infant and child mortality associated with the abatement of infectious diseases. These effects could be separate from those examined here. Finally, there is come controversy as to whether Granger causality should be qualified as "predictive causality." Some authorities would claim that "true causality" has philosophical undertones that cannot be addressed by mathematical methods. Future studies will attempt to address some of these limitations.

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