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ASSESSING THE INFLUENCE OF PUBLIC HEALTH ON POPULATION WELFARE: A FOCUS ON DEVELOPING COUNTRIES

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During the 1980s and 1990s, the majority of developing countries successfully implemented social security programs. To guarantee the enduring viability of these recently implemented systems, it is imperative to meticulously observe the economic ramifications. This study aims to analyze the influence of public health policies on population welfare using panel data from developing countries spanning from 2000 to 2021.
The study applies Two-Stage Least Square (2SLS) estimation techniques of panel data, instrumented by Age Dependency Ratio to solve the potential endogeneity problems between public health and population welfare.
Results indicate a strong positive and long-run correlation between public health and population welfare. Put simply, the research found that higher public health expenditure plays a significant role in determining the population welfare in developing countries over the long term. Conclusion the concept of growth driven by improvements in health in developing countries is validated.

Keywords: public health; population welfare; 2SLS; developing countries; economic growth

Introduction

Throughout the 1980s and 1990s, social security programs have been gradually implemented in developing countries. However, the social security systems of developing countries continue to encounter significant obstacles and conflicts, predominantly as a result of their delayed implementation in comparison to those of affluent nations. In order to improve the health and productivity of their inhabitants, these nations must increase their healthcare expenditure.

Nevertheless, it is imperative that they devise strategies to logically distribute health benefits in order to mitigate and amplify the detrimental effects of inefficient healthcare expenditure on economic development (Bloom et al., 2018).

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In recent years, the twenty-first century has experienced substantial demographic changes, such as population aging (Bloom et al. 2015) and declining fertility rates. Consequently, emerging nations are experiencing an escalating amount of pressure to improve their social security systems. Therefore, it is essential for developing countries to clarify the impact of healthcare expenditure on economic growth and its fundamental processes to establish a social security system that is both sustainable and long-lasting.

Among the developing countries public health has an impact on the well-being of the populations in the BRICS nations (Brazil, Russia, India, China, and South Africa). Longer lifespans, reduced disease prevalence, and improved living standards are all the results of robust public health systems. Each of these nations is home to approximately 40% of the global population, and while they each face unique health challenges, they also offer substantial opportunities in the field of public health.

At present, Brazil has effective public health measures, such as the Sistema Único de Saúde (SUS), which has enhanced the health of mothers and children and reduced the spread of infectious diseases. Currently, Russia has made substantial progress in the prevention and treatment of substance addiction and non-communicable diseases, both of which have a negative impact on the health of its population. The promotion of immunization and the eradication of diseases such as tuberculosis are the primary public health initiatives in India, as the population has a high prevalence of infectious diseases.

Several structural developments in China have resulted in an improvement in the country's health status, including increased expenditure on healthcare facilities and healthcare reforms. South Africa implements public health initiatives to address both communicable and non-communicable diseases, such as HIV/AIDS, Tuberculosis, and emergent non-communicable diseases.

The health-led growth hypothesis, which Muskin (1962) proposed, posits that healthcare expenditure plays a substantial role in the enhancement of population welfare. Health is regarded as a form of capital by this concept. Investing in health may lead to an increase in income, which in turn contributes to overall economic growth.

The accumulation of human and physical capital can be influenced by health, which in turn can affect economic growth (Bloom & Canning, 2000). In the same vein, individuals who are in better health are more effective and efficient in their tasks. Consequently, individuals who are in excellent health are highly motivated to improve their knowledge and skills, as they anticipate the benefits of doing so for an extended period. Conversely, the presence of underdevelopment in numerous regions worldwide is significantly influenced by poor health, which has a detrimental impact on production (Cole & Neumayer, 2006).

Economic expansion can improve the health of the populace through two mechanisms. Initially, economic expansion results in an increase in per capita income, which in turn leads to an item of greater expenditure on the consumption of a greater quantity of higher-quality nutritious food. As a consequence, there is an enhancement in health. Furthermore, the development of technology is essential for the stimulation of economic growth, and one manifestation of this progress is the improvement in the field of medical science.

The reports conducted by the European Commission (2005) and the World Health Organization (2001) has demonstrated that increased investment in healthcare can effectively stimulate GDP growth in both developed and developing countries.

Many researchers also concluded that health expenditures contribute significantly to population welfare (Bernier & Burlone, 2007; Joseph, 2022; Elliot et al., 2023).

In addition, economists are also interested in the influence of the social security system on economic development in relation to its impact on human capital, as informed by Lucas's endogenous growth theory (1988). In general, the provision of healthcare for individuals can be improved by increasing social security expenditure by promoting their overall well-being (Mayer & Sarin, 2005). This supplementary expenditure will also improve the quality of education and generate social benefits (Murphy & Topel, 2006). Therefore, social security expenditures have the potential to promote sustainable economic development by increasing labor productivity through investments in human capital (Bloom et al., 2018).

This study aims to analyze the influence of public health on the population welfare of the developing countries. The BRICS countries collectively represent 40% of the global population and consistently strive to improve the conditions within their respective nations. Their income is heavily dependent on the industrial sector. The health and population of a country are crucial factors in industrialized nations, as they have a substantial impact on the country's economic growth.

Furthermore, the BRICS countries have a substantial impact in this aspect as other nations draw lessons from their expertise and formulate their own policies. This study is the first to investigate the influence of public health on population welfare in developing countries, making it a unique and pioneering research endeavor. Furthermore, this study expands upon the limited existing research in terms of addressing the endogeneity problem between public health expenditures and population well-being. This study is of great value to policymakers and academicians as it provides a policy framework to improve population well-being.

Literature review

This literature review examines the impact of public health policies on population welfare across various regions and demographic contexts. Studies consistently demonstrate that effective public health interventions significantly enhance population health and reduce inequalities. Research highlights the critical role of health insurance benefits, preventive measures, and equitable access to healthcare in improving overall well-being. Furthermore, the integration of digitalization and targeted health subsidies shows promise in addressing healthcare challenges in developing countries.

Using data of 28 European countries, Thomson et al. (2016) investigated the impact of public health on population welfare. The outcomes from systematic review concluded that public health policies significantly improve the population health. They also reported that public health interventions reduce the health inequalities within the population.

Lim (2016) examined the influence of public health insurance benefits on individual welfare in a highly old-age dependent economy with the help of overlapping generations model. The findings stated that a positive change in health insurance benefits brings a significant change in the health outcomes and protect medical expenditure shocks benefiting the population.

Likewise, Farrow et al. (2022) determined the impact of public health on population welfare and found that public health initiatives enhance population welfare and reduce inequalities. Moreover, they stated that effective public health policy and practice heavily rely

on population health approaches to address health issues at a broader level and promote overall well-being in the communities.

Bernier & Burlone (2007) examined the relationship between public health policies and population welfare in the provinces of Canada and found that public health policies spur the population welfare in Canada.

Joseph (2022) explored the impact of public health interventions in a developing nation and found that public health interventions significantly enhance the population welfare in the developing countries. Moreover, he also stated that public health interventions significantly impact the determinants of health i.e., socio-economic factors, healthy behaviors, working with communities and effective health care.

Elliot et al. (2023) explored the impact of public health on population health in 48 states of the USA. Sexually transmitted diseases, human immunodeficiency, obesity prevalence and diabetes prevalence were examined in this study. The outcomes from fixed effect reported the no significant impact between them. Further, this study did not address the potential endogeneity of public health funding, suggesting the need for more detailed data and robust research approaches to determine if increases public funding leads to enhance population growth.

Suhrcke (2010) examined a relationship between health and fighting chronic diseases and concluded that health has high social welfare benefit and significantly impact the public welfare.

Atrash & Carpentier (2012) explored the impact of public health in the delivery healthcare system and found that public health escalates public welfare through preventive measures and interventions. Moreover, public health integrates sustainability to ensure future generation well-being. He also reported that the impact of promoting health and combating chronic diseases extends beyond individual well-being to have substantial implications for the economy. By prioritizing health initiatives, societies can not only improve public health outcomes but also drive economic growth and productivity in the long term.

McGovern et al. (2018) reported that public health programs significantly contribute in population welfare. Moreover, they reported that investing in cost-effective interventions improve population health that not only benefits individuals' health but also has positive effects on other aspects of life such as socializing, economic participation and leisure activities. Public health impacts positively population welfare through improved quality of life.

Moreover, he stated that strategies ensure fair access to education, employment and income are vital for maintaining health and well-being ultimately leading to increased productivity for social assistance (Budzyn, 2022).

Bloom & Canning (2000) reported that health significantly impacts welfare through productivity, saving demographics and education. Moreover, they also stated that the low cost of certain health interventions has widespread effects on population health that makes health a promising strategy for growth in developing countries. Mackenbach (2012) reported that welfare models in Europe impact population health and wellbeing.

Welander et al. (2015) deals with the question of how globalization and the democratic status of a country and the historical experience of democracy affect infant mortality. Research results show that globalization reduces child mortality, and the level of democracy in a country generally improves child health outcomes.

Liu & Sun (2012) examined the consequences of informal payment provision and the prohibition of informal payments on the welfare of the population. Informal payments are understood as payments to individuals or institutions in cash or in kind outside official channels for services to be covered by the public health care system. The Chinese government perceives these payments as bribes and has already introduced a measure that if a doctor is found to receive informal payments, the Ministry of Health will immediately suspend his license. Despite this, patients still offer doctors such payments. Many health professionals believe that patients offer informal payments to spark greater efforts by doctors, while others assume that the purpose of providing them is to conform to the social norm. As long as patients are rational subjects, they have to pay for something of value. The valuable ones in this regard can be more effort of doctors, choosing a better doctor, or a better position on the waiting list.

Hazen & Ehiri (2006) deal with road traffic injuries, which are the leading cause of morbidity, disability and mortality in developing countries. Nevertheless, little attention is paid to road safety in the public health of these countries. The consequences of injuries and disability as a result of road accidents are enormous due to their poorly developed trauma care systems and non-existent social security systems for the injured and disabled. One reason for this is that there are a number of other equally important problems in developing countries, including infectious diseases. Public health policy strategies in developing countries are often contradictory.

Data and methodology

Population welfare has a dual mechanism with public health. Investing in healthcare can result in a rise in earnings, which then adds to overall economic expansion. Health can have an impact on the accumulation of human and physical capital, which in turn can influence economic growth (Bloom & Canning, 2000).

Similarly, people who are in better health exhibit higher levels of effectiveness and efficiency in their work. Therefore, those who are in optimal physical condition are strongly driven to enhance their knowledge and abilities, as they foresee the advantages of doing so over a prolonged duration. On the other hand, the existence of underdevelopment in many parts of the world is greatly affected by inadequate health conditions, which have a harmful effect on productivity (Cole & Neumayer, 2006).

Econometric model specification

To study the impact of public health on the population welfare of the BRICS countries, first the study defines the econometric model equations of population welfare as following:

$$\Delta y_{it} = \beta_0 + \beta_1 PH + \beta_2 inflation_{it} + \beta_3 unemployment_{it} + \beta_4 economic\ growth_{it} + \theta_t + \sigma_i + \varepsilon_{it}$$

In the above econometric equations of population welfare Δy_{it} represents the first difference of real GDP Per Capita Growth as long at country i at time t. Additionally, $inflation_{it}$ represent the inflation based on CPI and we added to control for the potential impact of changes in the prices at macroeconomic level.

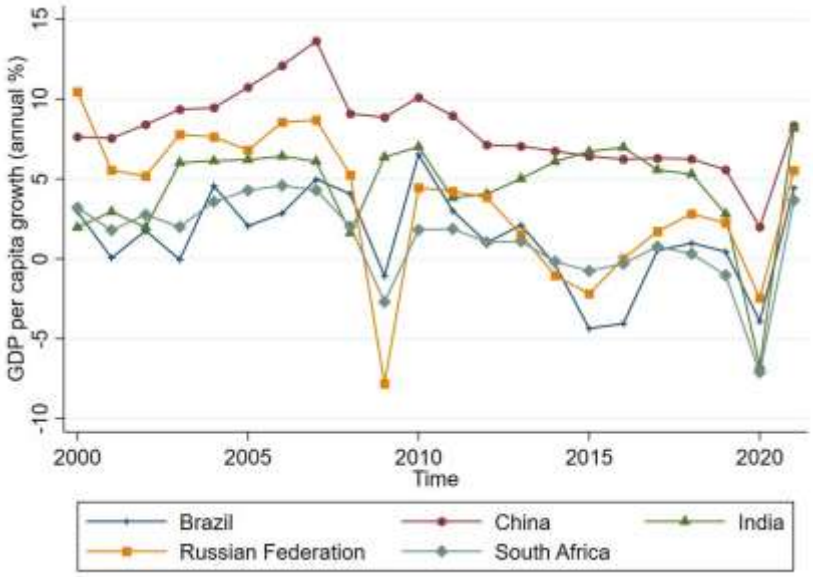

Figure 1 - Representation of population welfare and public health in BRICS countries.
(author's elaboration)

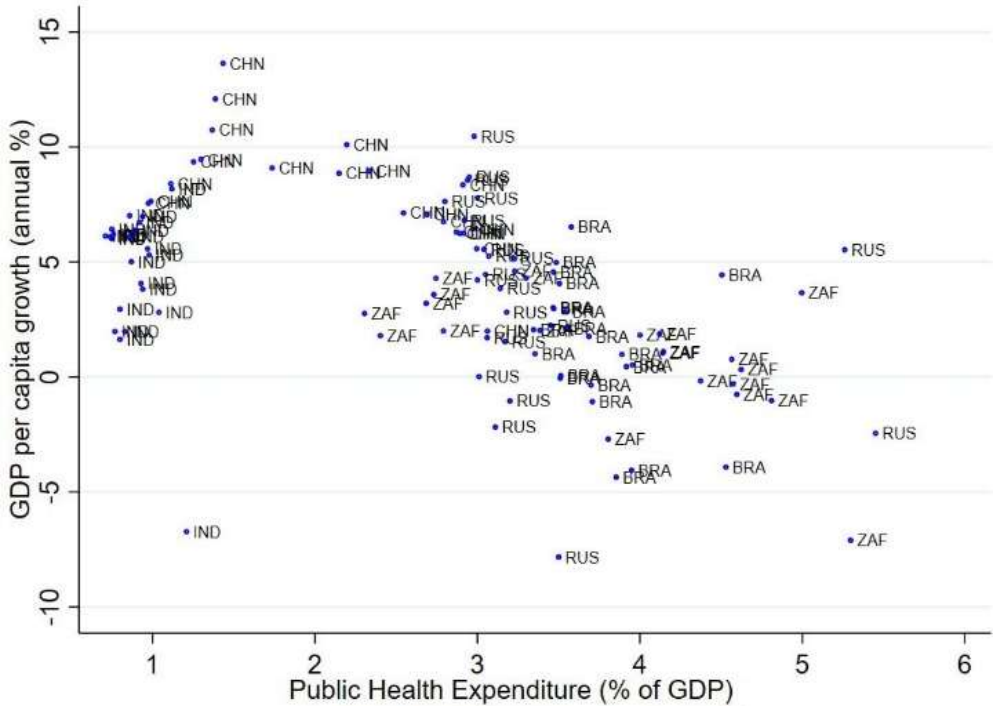

Figure 2 - Relationship of population welfare with public health in BRICS countries
(author's elaboration)

Further, $unemployment_{it}$ which is based on ILO estimation of measuring the unemployment rate is included in the model to control for economic recession and fluctuations. Additionally, $economic\ growth_{it}$ represent the GDP annual growth and we added to control for the economic cycles. Further, $\theta_t\ and\ \sigma_i$ represents time and country specific effects, and ε_{it} denotes the error term.

It is worth mentioning that the relationship between population welfare and public health is endogenous, and the result of ordinary least squares (OLS) and fixed effect models can be biased. To address this problem, we used an exogenous instrumental variable of age dependency ratio. It is the ratio of older dependents people (older than 64 years) to the working-age population (those ages 15-64).

Additionally, Xu et al. (2022) found in a study that the old-age dependency ratio and age significantly impact the health expenditure of urban families in China. Thus, to get an unbiased estimator we apply the 2SLS estimator based on exogenous instrumental variable of age dependency ratio for public health expenditure. We believe that the instrument is strongly exogenous and accomplishes the assumption of strong instrumental variables as shown on the proceeding correlation matrix in Tab. 3.

Thus, based on the above identification strategy and model the study intends to investigate the impact of public health expenditure on the population welfare of the BRICS countries. This clearly provides the answer to our research question as defined. Thus, the proceeding empirical analysis is based on the econometric model (1) with 2SLS estimation method for panel data.

Table 1 - Description of variables
(author's elaboration)

Variable	Definition	Measurement	Source
Population welfare	GDP per capita is gross domestic product divided by midyear population.	GDP per capita growth (annual %)	WDI
Public health	Public expenditure on health from domestic sources as a share of the economy as measured by GDP.	Domestic general government health expenditure (% of GDP)	WDI
Inflation	Consumer price index inflation measures annual change in average consumer costs.	Inflation, consumer prices (annual %)	WDI
Unemployment	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.	Unemployment, total (% of total labor force) (modeled ILO estimate)	WDI
Economic growth	Annual percentage growth rate of GDP at market prices based on constant 2015 prices US$.	GDP growth (annual %)	WDI
ADR	Is the ratio of older dependents--people older than 64--to the working-age population--those ages 15-64.	Age dependency ratio, old (% of working-age population)	WDI

Table 2 - Descriptive statistics
(author's elaboration)

Variable	Obs	Mean	Std. Dev.	Min	Max
Population welfare	110	3.754	4.021	-7.828	13.636
Public health	110	2.763	1.279	.71	5.45
Inflation CPI	110	5.944	3.98	-.732	21.477
Unemployment	110	10.205	6.378	3.26	28.77
Economic growth	110	4.58	3.948	-7.8	14.231
ADR	110	11.802	4.587	6.767	23.383

The study used secondary panel data which is mainly obtained from the World Development Indicators (WDI) databases for the period of 20 years from 2000-2021. We selected this period due to the availability of data related to public health expenditures. The data utilized consist of 6 main variables which are presented with their descriptive statistics in Tab. 1 and 2.

Results

For a more precise analysis, understanding the relation among dependent, independent, and instrumental variable, it is crucial to examine potential correlations among the variables under consideration. Typically, if the correlation between two variables is significant at 5%, it raises concerns for subsequent regression analyses. Regarding our specific variable for age dependency as an instrument, correlation with the dependent variable and public health indicates on the exogeneity of the instrument, as illustrated in Tab. 3.

Akinwande et al. (2015) considers VIF as important step before running a regression analysis to check for possible existence of multi-collinearity among the independent variables. For this purpose, we have the variance inflation factors (VIFs) test. As a role of thumb if the VIF exceeds 10, which usually happens when R2 exceeds 0.90, indicating on the existence of multi collinearity. To test for that we applied the VIF, and the result in Tab. 4. is indicating mean value of VIF 1.41 which is less than the threshold and thus no multicollinearity exists in our model as depicted in Tab. 4 below.

Moreover, the presence of Heteroscedasticity can lead to inaccurate standard error estimates for coefficients and, consequently, incorrect t-values. To assess this, we conducted the Breusch-Pagan test for heteroskedasticity for OLS structure of models. The result in Tab.5. accepts the null hypothesis of constant variance, indicating a potential for homoskedasticity and no risks of bias.

Further, a statistical test used in econometrics to identify cross-sectional dependency among individual units in a panel data environment is the Pesaran CD (Cross-Sectional dependency) test, created by Hashem Pesaran. Conventional panel data models assume that observations across various entities (e.g., country) are independent. This is not the case with cross-sectional dependency. Cross-sectional dependence poses a greater concern in macro panels with extended time series (beyond 20-30 years) than in micro panels.

The Pasaran CD test examines if residuals exhibit correlation across entities. This dependency can introduce bias in test outcomes, termed contemporaneous correlation, with the null hypothesis suggesting no correlation among residuals.

Based on the result, Tab. 6 indicates that there is no cross-sectional dependency among and observations across various panel and they are independent.

Table 3 - Pairwise correlations matrix
(author's elaboration)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Population Welfare	1.000					
(2) Public Health	-0.523*	1.000				
(3) Inflation	-0.112	0.094	1.000			
(4) Unemployment	-0.447*	0.492*	0.029	1.000		
(5) Economic growth	0.989*	-0.575*	-0.159	-0.403*	1.000	
(6) ADR	0.063	0.280*	0.237*	-0.507*	-0.062	1.000

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

Table 4 - Variance inflation factor
(author's elaboration)

	VIF	1/VIF
Public health	1.699	.589
Economic growth	1.566	.639
Unemployment	1.361	.735
Inflation CPI	1.028	.973
Mean VIF	1.413	

Table 5 - Heteroskedasticity test
(author's elaboration)

Assumption	Normal error terms
Variable	Fitted values of population welfare
H0	Constant variance
chi2(1)	2.21
Prob > chi2	0.1368

Table 6 - Pesaran's CD test
(author's elaboration)

Pesaran's test of cross-sectional independence	1.344, Pr = 0.1789
Average absolute value of the off-diagonal elements	0.285

Tab. 7 present the regression outcome of our analysis for OLS, FE, and 2SLS models. The outcomes from our regression analysis shows a positive and significant impact of public health on population welfare. This indicates that a 1% increase in the public health expenditure enhance population welfare growth in developing countries by 0.3%, which is consistent in OLS and 2SLS. Further, the regression outcome for model (1), (2), and (4) prevails that higher negative economic shock such as economic recession and higher unemployment rate decrease the population welfare, while economic growth and inflation increase it.

Additionally, model (3) presents the 1st stage regression result for the endogenous variable. The result clearly indicates that higher age dependency increases the public health expenditure in the selected countries. Further, in the 1st stage higher unemployment rate increase the public health expenditure while economic growth decreases it.

Thus, public health interventions aim to improve the quality of life for the general public by optimizing the allocation of resources, including time and money spent on healthcare, reducing the economic burden in terms of societal expenditures, and increasing productivity among the population. Implementing these preventative measures results in a decrease in the number of individuals contracting illness, thereby reducing the incidence of illness and, as a result, reducing the costs associated with treatment.

This enables the distribution of products to a larger population, thereby facilitating the efficient allocation of resources for the betterment of society. The enhancement of one's health results in an increase in productivity as an employee, which in turn leads to an increase in economic output. Furthermore, individuals who are in better health tend to have a higher standard of living and an extended lifespan. This allows them to participate in more productive activities, which can contribute to the long-term expansion of the economy.

The pandemic has had a substantial effect on health, particularly in terms of social determinants of health. The health of nations and the viability of the economy are influenced by social, economic, and environmental policies, as well as by policies and situations that result in health inequities. Outbreaks frequently result in avoidable premature fatalities and cause substantial economic damage.

By mitigating the repercussions of these epidemics, investing in improved public health systems and health education generates extraordinary advantages. Consequently, it is clear that public health is essential for the general welfare and prosperity of the population.

Table 7 - Regression result
(author's elaboration)

	(1)	(2)	(3)	(4)
	OLS & Fixed Effects Estimates		2SLS Estimates	
Variables	OLS	FE	1st Stage	2nd Stage
Public health	0.318***	0.0456	-	0.389***
	(0.0425)	(0.0603)		(0.102)
Inflation	0.0435***	0.0180*	-0.00753	0.0315**
	(0.0106)	(0.0104)	(0.0127)	(0.0123)
Unemployment	-0.0552***	0.00885	0.127***	-0.0483*
	(0.00763)	(0.0219)	(0.0240)	(0.0281)
Economic growth	1.037***	1.008***	-0.0339***	1.034***
	(0.0132)	(0.0109)	(0.0128)	(0.0137)
ADR	-	-	0.231***	-
			(0.0249)	
Constant	-1.572***	-1.189***	-1.063***	-1.751***
	(0.180)	(0.225)	(0.381)	(0.287)
Observations	110	110	110	110
R-squared	0.989	0.991	0.655	
Number of id	5	5	5	5

Conclusion and policy recommendation

This study indicates that program activities have a substantial and advantageous influence on the general welfare of the populace in the developing countries. The primary factor in achieving long-lasting reductions in mortality rates and an overall improvement in health status has been the implementation of proactive government initiatives aimed at enhancing public health, such as expanding immunization programs and disease control and preventive efforts. Paradoxically, this has been the case.

The prevention of a decline in the quality of life was effectively averted because of the enhanced economic stability and growth that resulted from these advancements. Continual foreign investment in public health is essential for the attainment of long-term social benefits, as it is emphasized in this research study. It is argued that the developing countries' continuous advancement is contingent upon the establishment of robust healthcare delivery systems.

The influence of public health on the well-being of the populace in the developing countries is an essential component of this investigation, as it has substantial policy implications. National leaders need to prioritize the expansion of public health budgets and exhibit a constant commitment to more substantial investment in preventative measures, immunization campaigns, and fundamental healthcare infrastructure. Additionally, the research suggests that the healthcare system and human resources must be strengthened to sustain and improve these advancements. To promote cooperation and facilitate the sharing of resources, it is occasionally necessary to implement policy measures that encourage cross-sector and international collaboration.

Additionally, it is imperative to adapt programs that prioritize the needs and preferences of individual clients to instead concentrate on addressing social factors that influence health outcomes, such as sanitation and education. Their endeavors will not only enhance the health outcomes of their citizens but also foster socio-economic development and human security in the developing countries. This study specifically concentrates on BRICS countries, which is of utmost importance to emphasize. Hence, the recommendations and findings may not be relevant or applicable to other nations.

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