International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 10 No. 4, 2024
https://theaspd.com/index.php

Rethinking Health Priorities in SAARC: An Empirical Assessment of Outcome Drivers

Bhola Khan[1]*, Manzoor Alam[2], Md Masroor Alam[3], Nasim Ansari[4], Iqbal Zafar Ansari[5], Sheela Yadav[6]
[1]Department of Regional Economics, MJP Rohilkhand University, Bareilly, U.P., India
[2] Department of Economics, D.A.V. Post Graduate College, Siwan Jai Prakash University, Chapra, Bihar, India. Email: manzoor.alig@gmail.com
[3]University Department of Economics, L.N. Mithila University, Kameshwar Nagar, Darbhanga, Bihar, India. Email: masrooreco@gmail.com
[4]Department of Economics, D.A.V. Post Graduate College, Siwan Jai Prakash University, Chapra, Bihar, India. Email: alignasim@gmail.com
[5]Department of Economics, Rajendra College, Chapra, Jai Prakash University, Chapra, Bihar, India. Email: iqbalzafaransari@gmail.com
[6]University Department of Economics, L.N. Mithila University, Kameshwar Nagar, Darbhanga, Bihar, India. Email: sheelaeconomics@gmail.com

Abstract
The health of individuals is a fundamental component of their overall well-being and their capacity to contribute meaningfully to society and national development. This study investigates the determinants of health outcomes across the South Asian Association for Regional Cooperation (SAARC) countries. Specifically, it examines the impact of ten independent variables on three key health indicators: infant mortality rate, child mortality rate, and total mortality rate. The analysis is based on secondary panel data spanning the period from 1991 to 2023, drawn from the World Bank and World Development Indicators. To evaluate the relationships between the variables, both fixed effects and random effects models were employed. Based on the results of the Hausman test, the random effects model was found to be more appropriate for deriving policy recommendations. One of the most notable findings is the statistically significant negative relationship between the prevalence of HIV and all three mortality indicators, particularly in the case of child mortality, where the association is significant at the 1% level. This underscores the urgent need for targeted interventions. The study recommends that SAARC governments prioritize efforts to reduce HIV prevalence among children under five through timely and effective healthcare policies. Such measures are vital for improving child survival rates and enhancing overall public health outcomes in the region.
Key Words: *Prevalence of H.I.V., S.A.A.R.C. nations, Panel Data, Child Mortality.*

INTRODUCTION

The South Asian Association for Regional Cooperation (SAARC) is a regional intergovernmental organization and geopolitical union comprising eight South Asian nations: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. As of 2021, the SAARC region accounts for approximately 3% of the world's land area, 21% of the global population, and contributes around 5.21% to the global economy. Health is a fundamental pillar of economic development and social well-being. It plays a crucial role in shaping human capital and driving long-term economic growth. Despite its importance, health remains one of the least prioritized sectors in many developing countries, including those in the SAARC region. An analysis of current health expenditure as a percentage of Gross Domestic Product (GDP) for selected years (as shown in Table 1) reveals stark contrasts among SAARC member countries. Afghanistan has allocated the highest share of GDP to health expenditure (13.80%), while Bangladesh has consistently allocated the lowest share (2.31%). From 2014 to 2019, the average health expenditure across SAARC countries remained largely stagnant, indicating limited progress in improving healthcare financing. However, during the period from 2020 to 2021, there was a noticeable increase in health spending—likely in response to the COVID-19 pandemic. Despite this increase, health expenditure levels in SAARC nations remain insufficient when assessed against the region's large population base and in comparison to other regional blocs such as ASEAN or the European Union. This underinvestment continues to pose challenges to achieving better health outcomes and building resilient healthcare systems.

[1] Correspondence Author: bholakhan1512@gmail.com (**ORCID ID:** 0000-0002-4479-2762)

In addition to public health expenditure, the study also analyses out-of-pocket (OOP) health expenditure—a critical indicator of the financial burden placed directly on individuals and households. Using data from the past eight years (2014–2021), as shown in Table 2, the findings reveal a gradual decline in the average OOP health expenditure (as a percentage of total current health expenditure) across SAARC countries.

In 2014, the average OOP expenditure in the region was 54.31%, which declined to 41.19% by 2021. This reduction suggests some progress in health financing systems, potentially due to increased public investment or expansion of healthcare services. However, the decline has not been uniform across all countries.

At the country level, Afghanistan continues to exhibit the highest OOP health expenditure at 75.95%, indicating a significant reliance on personal spending for healthcare services. In contrast, Bhutan reports the lowest OOP expenditure at 17.45%, suggesting a stronger public health support system or greater insurance coverage.

Despite the overall downward trend, the regional average has shown signs of stagnation in recent years, reflecting persistent gaps in financial protection mechanisms and limited progress in ensuring universal health coverage. This stagnation underscores the need for comprehensive health financing reforms and improved access to affordable healthcare across the SAARC region.

Given that health expenditure as a percentage of GDP plays a crucial role in shaping health outcomes, it is essential to analyse the current status of health indicators and their underlying determinants within the SAARC region. However, the relationship between health outcomes and their determinants is often complex and context-dependent. At times, the associations may be statistically significant and policy-relevant, while in other cases, they may prove to be weak or insignificant due to varying socioeconomic and demographic factors.

To explore these dynamics, the present study employs a panel data regression model, which allows for the analysis of both cross-country and temporal variations across SAARC nations over a period of time. This method provides more robust and reliable estimates by controlling for unobserved heterogeneity.

The study focuses on three key health outcome indicators:

- Infant Mortality Rate (IMR)
- Child Mortality Rate (CMR)
- Total Mortality Rate (TMR)

To identify the determinants of these health outcomes, the following ten independent variables have been selected based on theoretical relevance and data availability:

- Public Health Expenditure (% of GDP)
- Private Health Expenditure (% of GDP)
- Life Expectancy
- Access to Sanitation Facilities
- HIV Prevalence
- Gross Domestic Product (GDP) per capita
- Immunization Coverage (DPT)
- Proportion of Population Aged 0–14
- Rural Population (% of total population)
- Urban Population (% of total population)

This comprehensive set of variables is intended to capture the economic, demographic, and infrastructural dimensions influencing health outcomes, thereby enabling a holistic understanding of health challenges and policy gaps in the SAARC region.

Table-1 Percentage of Current Expenditure of GDP on Health

Sr./No.	Country	2014	2015	2016	2017	2018	2019	2020	2021	Average
1.	Afghanistan	9.52	10.10	11.82	12.62	14.21	14.83	15.53	21.8	13.80
2.	Bangladesh	2.27	2.27	2.39	2.37	2.32	2.26	2.27	2.36	2.31
3.	Bhutan	3.55	3.75	3.58	3.34	3.24	3.60	4.36	3.85	3.66
4.	India	3.62	3.6	3.5	2.94	2.86	2.95	3.34	3.28	3.26
5.	Maldives	7.91	8.73	10.31	9.27	7.44	7.66	11.35	10.03	9.09
6.	Nepal	5.08	5.47	5.42	4.72	4.53	4.45	5.21	5.42	5.04
7.	Pakistan	2.45	2.46	2.57	2.79	2.83	2.85	2.95	2.91	2.73
8.	Sri Lanka	3.47	3.68	3.62	3.33	3.64	3.9	4.02	4.07	3.72

Total Average % of current Expenditure of GDP on Health	**4.74**	**5.01**	**5.40**	**5.17**	**5.13**	**5.31**	**6.13**	**6.72**	**5.45** **5.45**

Source: World Development Indicators (WDI).

Table-2 OOP Health Expenditure (% of current expenditure)

Sr./No.	Country	2014	2015	2016	2017	2018	2019	2020	2021	Average
1.	Afghanistan	73.06	78.06	75.97	75.48	76.22	76.82	74.81	77.21	75.95
2.	Bangladesh	70.76	72.67	71.49	70.09	70.68	72.05	74.00	72.99	71.84
3.	Bhutan	21.17	19.79	20.13	13.31	13.16	17.79	15.42	18.80	17.45
4.	India	67.01	64.66	63.21	55.11	53.23	52.00	49.45	49.82	56.81
5.	Maldives	28.12	19.45	18.93	20.59	19.78	17.46	16.91	14.33	19.45
6.	Nepal	60.05	59.44	55.44	57.38	57.73	57.91	54.17	51.26	56.67
7.	Pakistan	65.62	64.58	62.30	58.02	56.43	56.28	55.44	57.50	59.52
8.	Sri Lanka	48.68	48.93	50.12	49.25	46.82	45.51	43.76	43.64	47.09
Total Average OOP Health Expenditure (% of current expenditure)		**54.31**	**53.44**	**52.20**	**49.90**	**49.25**	**49.48**	**48.00**	**48.19**	**50.60** **50.60**

Source: World Development Indicators (WDI).

LITERATURE REVIEW

A literature review serves as a critical foundation for identifying existing research gaps and formulating study objectives that aim to address unresolved issues. In line with this, the present study explores relevant literature on the relationship between health expenditure and health outcomes, with a particular focus on SAARC nations and comparative regions.

Mohapatra (2023) conducted a 20-year panel data analysis (1993–2012) across seven SAARC countries and found that increased public health expenditure directly improves health outcomes. Notably, out-of-pocket (OOP) expenditure was associated with higher life expectancy and better indicators such as infant mortality, tuberculosis prevalence, and death rates. The study highlighted the importance of exploring the nuanced relationship between various forms of health expenditure and specific health outcomes, particularly in the context of regional disparities.

Singh, Bala, and Kumar (2022) assessed the impact of public and private health expenditure on health outcomes in Southeast Asia using fixed and random effects models. Their findings show that public expenditure significantly improves life expectancy and reduces under-five and non-communicable disease mortality rates. However, only in Brunei and Singapore did both public and private health expenditures demonstrate a consistently positive impact.

Unyaminu et al. (2022), using dynamic panel GMM on data from 43 African countries (2000–2018), found a statistically significant and positive relationship between total health expenditure and life expectancy. The study also noted that school enrolment and economic activity played vital roles in improving life expectancy, and recommended increasing health budget allocations.

In a similar context, Arthur and Oaikhenan (2017) examined 40 Sub-Saharan African countries using the Grossman Human Capital Model. Their results indicated that while health expenditure positively impacts health outcomes, the relationship is inelastic. Public expenditure was more effective in reducing mortality, whereas private expenditure significantly influenced life expectancy. Kim and Lane (2013) investigated 27 years of data from 17 OECD countries and concluded that higher government spending on health significantly improves infant mortality and life expectancy. Their work reinforces the value of public financing in shaping national health status. Hassan et al. (2014) explored the triadic relationship between healthcare expenditure, economic growth, and health outcomes in SAARC countries over 15 years. Using panel cointegration techniques, the study found that healthcare expenditures were treated as a luxury, as indicated by their inverse relationship with life expectancy and the aging population. Infant mortality remained largely unaffected by healthcare spending, suggesting a need for structural reforms including tax policy, food pricing, and trade liberalization for medical equipment.

Aziz et al. (2021) studied the link between health expenditure and maternal mortality across South Asian countries using FMOLS and DOLS. Surprisingly, they found a positive relationship, suggesting that the current healthcare infrastructure may be inadequate in addressing maternal health challenges.

Shaikh and Singh (2016) analysed 19 years of healthcare expenditure data across seven South Asian countries. They noted that Maldives had the highest per capita healthcare spending, while India had the highest proportion of out-of-pocket expenditure. The study identified GDP and household spending as key determinants of out-of-pocket health expenses.

Khan et al. (2016) explored the link between healthcare expenditure and economic growth in SAARC countries using panel cointegration and causality analysis. Their results revealed low elasticity of healthcare spending, again treating it as a luxury. A unidirectional causality was observed from GDP to health expenditure in the short run.

Rahman and Alam (2021) examined the interplay of health expenditure, energy consumption, and environmental pollution in the SAARC-BIMSTEC region using a Panel ARDL model. Their results confirmed long-run cointegration among the variables and emphasized the significance of energy and health spending in improving health outcomes. Environmental pollution had a negative effect, prompting the need for integrated policy action.

Sharma and Bothra (2017) assessed the impact of public health expenditure on health status across South Asian nations. Utilizing a fixed effects model with lagged variables, they found that health status was influenced not only by health spending but also by broader socio-economic factors such as education, poverty, and governance.

Odhiambo (2021) reported unidirectional causality from public health expenditure to economic growth in low-income Sub-Saharan African countries, whereas private expenditure was influenced by economic growth in middle-income countries.

Grima et al. (2018) evaluated healthcare facilities and expenditure in six Mediterranean countries, revealing significantly lower healthcare investment compared to the EU average, both in GDP percentage and per capita terms—largely due to economic constraints.

Jafrin et al. (2021) used 16 years of panel data to identify determinants of life expectancy in SAARC countries. Schooling and sanitation had a positive impact, while total fertility rate, urbanization, and CO_2 emissions were negatively associated with life expectancy.

Jain and Sarma (2019) explored the environmental determinants of health expenditure across 35 Asian countries using a fixed effects model. Their findings linked CO_2 emissions and particulate matter concentration with increased per capita health expenditure. National income was also found to drive healthcare spending for the elderly.

The reviewed literature highlights significant insights into the impact of health expenditure on various health outcomes across diverse regions. However, several gaps remain:

- Most studies either focus on a single health outcome or limit themselves to shorter time spans.
- Limited research specifically investigates SAARC countries in a unified framework using comprehensive variables and longitudinal panel data.
- The combined effects of public, private, and OOP expenditures alongside environmental, demographic, and social determinants are rarely examined in an integrated model.

The present study addresses these gaps by analysing panel data from 1991–2023 across SAARC nations. It incorporates three major health outcomes—infant mortality, child mortality, and total mortality—and examines their association with a broad set of independent variables including public and private health expenditure, life expectancy, sanitation, HIV prevalence, GDP, immunization (DPT), 0–14 age group population, and urban-rural demographics. The study formulates three key objectives to investigate the relationships between these health outcomes and their determinants, aiming to provide evidence-based policy recommendations for improving health expenditure strategies and achieving better health indicators in the region.

Objective

The primary objective of this study is to investigate the determinants of health outcomes in the South Asian Association for Regional Cooperation (SAARC) countries. Specifically, the study aims to analyze how public and private health expenditures, demographic, and socio-economic factors influence key health indicators.

The specific objectives of the study are as follows:

1. **To analyze the impact** of public health expenditure, private health expenditure, life expectancy, sanitation, HIV prevalence, immunization against DPT, Gross Domestic Product (GDP), population aged 0–14 years, and rural and urban population distribution on **infant mortality** in SAARC countries.
2. **To examine the relationship** between public health expenditure, private health expenditure, life expectancy, sanitation, HIV prevalence, immunization against DPT, GDP, population aged 0–14 years, and rural and urban population on **child mortality** in SAARC countries.
3. **To assess the direction of causality** between public health expenditure, private health expenditure, life expectancy, sanitation, HIV prevalence, immunization against DPT, GDP, population aged 0–14 years, and rural and urban population on **total mortality** in SAARC countries.

Hypotheses

Based on the study's objectives, the following null hypotheses (H_0) have been formulated to assess the relationship between health determinants and health outcomes in SAARC countries:

H_{01}: Public health expenditures, private health expenditures, life expectancy, sanitation, HIV prevalence, immunization against DPT, Gross Domestic Product (GDP), the 0–14 age group population, and rural and urban population have no significant effect on infant mortality in SAARC countries.

H_{02}: Public health expenditures, private health expenditures, life expectancy, sanitation, HIV prevalence, immunization against DPT, Gross Domestic Product (GDP), the 0–14 age group population, and rural and urban population have no significant effect on child mortality in SAARC countries.

H_{03}: There is no significant relationship between public health expenditures, private health expenditures, life expectancy, sanitation, HIV prevalence, immunization against DPT, Gross Domestic Product (GDP), the 0–14 age group population, rural and urban population, and total mortality in SAARC countries.

METHODOLOGY

One should use an appropriate methodology to address the study's hypotheses and find a possible solution. The study has utilized 33 years of (1991-2023) secondary data on 13 variables, such as infant mortality, child mortality, and total mortality, while public health expenditure, private health expenditure, life expectancy, Sanitation, H.I.V. prevalence, immunization against D.P.T., Gross Domestic Product (G.D.P.), 0-14 age group population, rural and urban population as independent variables, for S.A.A.R.C. countries and all the data is taken from World Development Indicators, 2023. For the data analysis, the study relied on panel data regression. The present study has used infant mortality, child mortality, and total mortality as outcome variables (dependent variables) and ten variables as independent for all three outcome variables. After employing the pooled O.L.S., Fixed Effect Model (F.E.M.), and Random Effect Model (R.E.M.), the study ran the Hausman Test to check endogeneity. The functional form of all three-panel data regression equations is as follows.

INFMRT= F (PHE, PRHE, LE, SANIT, HIV, DPT, GDP, POPAG_0_14, RURLPOP, URBNPOP) ……………………………………………………………………………………………1

CHILDMRT= F (PHE, PRHE, LE, SANIT, HIV, DPT, GDP, POPAG_0_14, RURLPOP, URBNPOP) ……………………………………………………………………………………………2

TOTLMRT= F (PHE, PRHE, LE, SANIT, HIV, DPT, GDP, POPAG_0_14, RURLPOP, URBNPOP) ……………………………………………………………………………………………3

Where, NFMRT = Infant Mortality, PHE = Public Health Expenditure, RHE= Private Health Expenditure, LE= Life Expectancy, SANIT= Sanitation, HIV= HIV prevalence, DPT= Diphtheria, GDP= Gross Domestic Product, POPAG_0_14= Population age 0-14, RURLPOP =Rural Population, URBNPOP= Urban Population.

Equations 1, 2, and 3 show the functional relation among the dependent and independent variables and cannot be estimated. To estimate all three functional equations, we transformed them into regression equations 4,5 and 6, which are given below in the log form. Equations 4,5 and 6 can be transformed into equations 7,8 and 9.

lnINFMRTit=ßo+ß1lnPHEit+ß2lnPRHEit+ß3lnLEit+ß4lnSANITit+ß5lnHIVit+ß6lnDPTit+ß7lnGDPit+ß8lnPOPAG_0_14it+ß9lnRURLPOPit+ß10lnURBNPOPit+µit…………………4

lnCHILDMRTit=ßo+ß1lnPHEit+ß2lnPRHEit+ß3lnLEit+ß4lnSANITit+ß5lnHIVit+ß6lnDPTit+ß7lnGDPit+ß8lnPOPAG_0_14it+ß9lnRURLPOPit+ß10lnURBNPOPit+µit……………..5

lnTOTLMRTit=ßo+ß1lnPHEit+ß2lnPRHEit+ß3lnLEit+ß4lnSANITit+ß5lnHIVit+ß6lnDPTit+ß7lnGDPit+ß8ln POPAG_0_14it+ß9lnRURLPOPit+ß10lnURBNPOPit+µit…………………………….6

lnYit=α+β1lnXit1+β2lnit2+β3lnXit3+β4lnXit4+β5lnXit5+β6lnXit6+β7lnXit7++β8lnXit8+ ß9lnXit9+ß10lnXit10+μit...7
lnYit=α+β1lnXit1+β2lnit2+β3lnXit3+β4lnXit4+β5lnXit5+β6lnXit6+β7lnXit7++β8lnXit8+ ß9lnXit9+ß10lnXit10+μit...8
lnYit=α+β1lnXit1+β2lnit2+β3lnXit3+β4lnXit4+β5lnXit5+β6lnXit6+β7lnXit7++β8lnXit8+ ß9lnXit9+ß10lnXit10+μit...9

RESULTS AND DISCUSSION

We run Pooled O.L.S. regression, Fixed Effect Model, and Random Effect Model using data on S.A.A.R.C. nations from 1991-2023. Due to limitations, other variables could not be included in the study analysis. However, it should be noted that our sample includes all the significant variables that may indicated as the determinants of health outcomes in the region. Our model uses infant Mortality, child mortality, and total mortality rates as dependent variables. We included the log value of all the variables in our study.

First, we run Pooled Ordinary Least Square regression. One can see the results in Table 1: the effect of public health expenditure, Sanitation, immunization against D.P.T., Gross Domestic Product (G.D.P.), 0-14 age population and urban population have a positive and statistically significant impact on infant mortality rate in the S.A.A.R.C. countries. However, these impacts are meagre. In contrast, the effect of private health expenditure, life expectancy, the prevalence of H.I.V., D.P.T., and rural population have negative but statistically significant impacts on the infant mortality rate in the region.

The value of R square is 95 per cent, which means the explanatory variables explain the explained variable at a rate of 95 per cent. The p-value of the F-test is statistically significant at the 1 per cent level, which reveals that the estimated model is highly specified, and some of the results are directly supported by Jain, Y., & Sarma A. (2019).

Table 3: Pooled OLS for Infant Mortality

Dependent Variable: INFMORT				
Method: Panel Least Squares				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	320.71	6.67	48.02	0.00
PHE	0.01	0.00	3.52	0.00
PRHE	-0.09	0.02	-3.26	0.00
LE	-3.86	0.14	-26.26	0.00
SANITATION	0.046	0.02	1.78	0.07
HIV	-41.59	7.28	-5.70	0.00
DPT	-0.15	0.04	-3.44	0.00
GDP	0.14	0.06	2.31	0.02
POPAG_0_14	7.00	4.83	14.49	0.00
RURALPOP	-3.90	3.23	-12.08	0.00
URBANPOP	2.10	3.12	6.71	0.00
R-squared	**0.956**	Mean dependent var		48.085
Adjusted R-squared	0.954	S.D. dependent var		27.898
S.E. of regression	5.962	Akaike info criterion		6.450
Sum squared resid	8710.775	Schwarz criterion		6.603
Log likelihood	-814.722	Hannan-Quinn criter.		6.512
F-statistic	533.723	Durbin-Watson stat		2.442
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI).

For vigorous and apt results after the panel data sets, primarily, one can run the Fixed Effect Model (F.E.M.) and Random Effect Model (R.E.M.) and tables 3 and 4 show the results of both models. It is evident from the Fixed Effect Model regression results (table 3) that the life expectancy, prevalence of H.I.V., immunization against D.P.T., and rural population have a negative relationship with infant mortality rate. However, all are statistically significant at a one per cent level. Moreover, the value of the F-state is about 167.93, and its probability value is statistically significant at a one per cent level, which indicates that the model is highly specified.

Table 4: Fixed Effect Model (FEM)

Dependent Variable: INFMORT				
Method: Panel Least Squares				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	281.70	7.51	37.46	0.00
PHE	0.02	0.00	6.26	0.00
PRHE	0.02	0.02	0.84	0.39
LE	-3.45	0.14	-24.36	0.00
SANITATION	0.13	0.02	5.46	0.00
HIV	-21.39	7.15	-2.99	0.00
DPT	-0.13	0.04	-3.44	0.00
GDP	0.06	0.06	1.07	0.28
POPAG_0_14	8.08	4.43	18.23	0.00
RURALPOP	-5.12	3.14	-16.30	0.00
URBANPOP	3.57	3.18	11.22	0.00
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	**0.969**	Mean dependent var	48.085	
Adjusted R-squared	0.964	S.D. dependent var	27.898	
S.E. of regression	5.287	Akaike info criterion	6.317	
Sum squared resid	5982.572	Schwarz criterion	6.899	
Log likelihood	-766.631	Hannan-Quinn criter.	6.551	
F-statistic	167.937	Durbin-Watson stat	3.085	
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI)

Additionally, we run the Random Effect Model (R.E.M.) and its estimates are given in Table 4. The coefficient value of public health expenditure, Sanitation, Gross Domestic Product (G.D.P.), population growth and urban population is positive and statistically significant. Therefore, these variables positively impact the infant mortality rate in the region. However, the coefficient value of private health expenditure, life expectancy, prevalence of H.I.V., immunization against D.P.T., and rural population are negative and statistically significant. The value of F-stat is about 533.72, and its probability is statistically significant at a one per cent level, which indicates that the R.E.M. is also highly specified.

Table 5: Random Effect Model (REM)

Dependent Variable: INFMORT				
Method: Panel EGLS (Cross-section random effects)				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Swamy and Arora estimator of component variances				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	320.71	5.92	54.15	0.00
PHE	0.01	0.00	3.97	0.00
PRHE	-0.09	0.02	-3.68	0.00
LE	-3.86	0.13	-29.62	0.00
SANITATION	0.04	0.02	2.01	0.04
HIV	-41.59	6.46	-6.43	0.00
DPT	-0.15	0.03	-3.88	0.00
GDP	0.14	0.05	2.60	0.00
POPAG_0_14	7.00	4.29	16.34	0.00
RURALPOP	-3.90	2.86	-13.62	0.00
URBANPOP	2.10	2.77	7.57	0.00
R-squared	**0.956111**	Mean dependent var		48.08555
Adjusted R-squared	0.954319	S.D. dependent var		27.89840
S.E. of regression	5.962733	Sum squared resid		8710.775
F-statistic	533.7235	Durbin-Watson stat		2.442836
Prob(F-statistic)	**0.000000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI).

Furthermore, to check the viability of the model, we employed the Hausman test over both F.E.M. and R.E.M., and we concluded that the Hausman test could run only on the R.E.M., in this case, and therefore, we only stuck on it and the estimates of it are given in table 5. one can see from table 5 that the probability value of Chi-square is 0.00 per cent and therefore, the null hypothesis has been accepted. The alternative has been rejected, and one can conclude that the Random Effect Model is appropriate for the data analysis. We take the Random Effect Model (R.E.M.) results from Table 4.

Table 6: Hausman Test

Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	97.417	10	0.000

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

In this study, we are examining three outcome variables, one of which is infant mortality. The above estimates (Tables 3, 4, and 5) show that the independent variables have mixed effects on the dependent outcome variable. In infant mortality, R.E.M. is an appropriate model for the study in the S.A.A.R.C. region.

Furthermore, we employed both the Fixed Effect Model (F.E.M.) and Random Effect Model (R.E.M.) over the second outcome variable (Child Mortality). It is evident from Table 6 that public health expenditure, private health expenditure, Sanitation, Gross Domestic Product (G.D.P.), population growth rate and urban population have had a positive impact on the child mortality rate in the S.A.A.R.C. region; however, only four variables are statistically significant at one per cent level, and two are statistically insignificant while life expectancy at birth prevalence of H.I.V., immunization against D.P.T. and rural population and having negative and statistically significant impact over the child mortality rate in the region. Furthermore, the probability value of the F-stat is statistically significant at a one per cent level, which rectifies that the model is highly specified.
Table 7 revealed the estimates of the Random Effect Model and the public health expenditure, Sanitation, G.D.P., population growth, and urban population have positive and statistical significance, except sanitation impact on child mortality in the region, while private health expenditure, life expectancy at birth, prevalence of H.I.V., immunization against D.P.T., and rural population are having negative and statistically significant impact over the child mortality rate in the region. One can see from Table 6 7 that one of the essential differences between the results of F.E.M. and R.E.M. is the effect of private health expenditure on child mortality in the region; in the case of F.E.M., it is having a positive impact on the second outcome variable while R.E.M. estimates indicated that the effect of private health expenditure over the child mortality is having negative.
Moreover, we also checked the feasibility of the F.E.M. and R.E.M. estimates of the Hausman test, indicating that the Random Effect Model is appropriate (since the probability value of Chi-Square statistics is significant at the one per cent level, Table 8). Its results are more valid in this case.

Table 7: Fixed Effect Model (FEM)

Dependent Variable: CHILDMORT				
Method: Panel Least Squares				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	415.13	10.39	39.94	0.00
PHE	0.03	0.00	7.45	0.00
PRHE	0.01	0.03	0.49	0.62
LE	-5.14	0.19	-26.27	0.00
SANITATION	0.15	0.03	4.49	0.00
HIV	-31.87	9.88	-3.22	0.00
DPT	-0.22	0.05	-3.96	0.00
GDP	0.11	0.08	1.34	0.17
POPAG_0_14	7.92	6.12	12.93	0.00
RURALPOP	-4.73	4.34	-10.89	0.00
URBANPOP	2.97	4.39	6.75	0.00
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	**0.971**	Mean dependent var		63.593
Adjusted R-squared	0.966	S.D. dependent var		39.754
S.E. of regression	7.306	Akaike info criterion		6.964
Sum squared resid	11425.41	Schwarz criterion		7.546
Log likelihood	-849.445	Hannan-Quinn criter.		7.198
F-statistic	178.888	Durbin-Watson stat		2.927
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI).

Table 8: Random Effect Model (REM)

Dependent Variable: CHILDMORT				
Method: Panel EGLS (Cross-section random effects)				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Swamy and Arora estimator of component variances				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	467.77	8.18	57.15	0.00
PHE	0.02	0.00	5.37	0.00
PRHE	-0.14	0.03	-4.00	0.00
LE	-5.69	0.18	-31.60	0.00
SANITATION	0.04	0.03	1.268	0.20
HIV	-60.75	8.92	-6.80	0.00
DPT	-0.24	0.05	-4.40	0.00
GDP	0.20	0.07	2.60	0.00
POPAG_0_14	6.53	5.92	11.02	0.00
RURALPOP	-3.14	3.96	-7.93	0.00
URBANPOP	1.05	3.82	2.75	0.00
R-squared	**0.960**	Mean dependent var		63.593
Adjusted R-squared	0.958	S.D. dependent var		39.754
S.E. of regression	8.096	Sum squared resid		16062.01
F-statistic	590.224	Durbin-Watson stat		2.372
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI).

Table 9: Hausman Test on Random Effect Model

Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	86.338	10	0.000

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

After checking the estimates of two outcome variables, which are infant mortality and child mortality, we are looking after the effect of all ten independent variables over the total mortality rate in the S.A.A.R.C. region and the estimates of the Fixed Effect Model and Random Effect Model are given as below in table 9 and 10. The fixed Effect Model estimate indicates that the effect of public health expenditure, private health expenditure, life expectancy at birth, Sanitation, immunization against D.P.T., and rural and urban populations are pessimistic over the total mortality rate in the region. However, the prevalence of H.I.V., Gross Domestic Product (G.D.P.), and population (age 0-14) are harming the total mortality in the region. Furthermore, the probability value of F-statistics is significant at one per cent level, which indicates that the estimated model is highly specified.

Moreover, table 10 revealed the estimates of the Random Effect Model (R.E.M.), and out of ten independent variables, only the population aged 0-14 must have a positive and statistically insignificant impact on the total mortality rate in the region. However, the other nine have negative and statistically significant impacts (except for the prevalence of H.I.V., G.D.P., and rural population) on the total mortality rate in the S.A.A.R.C. regions. Furthermore, we also ran the Hausman test for the feasibility of the model, and it was found that the Random Effect Model (R.E.M.) is appropriate.

Table 10: Fixed Effect Model (FEM)

Dependent Variable: TOTMORTRAT				
Method: Panel Least Squares				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	23.83	1.21	19.55	0.00
PHE	-0.00	0.00	-7.14	0.00
PRHE	-0.02	0.00	-4.64	0.00
LE	-0.15	0.02	-6.61	0.00
SANITATION	-0.01	0.00	-2.83	0.00
HIV	0.44	1.15	0.38	0.70
DPT	-0.05	0.00	-8.07	0.00
GDP	0.00	0.01	0.02	0.97
POPAG_0_14	2.59	1.47	1.76	0.07
RURALPOP	-6.28	6.76	-0.92	0.35
URBANPOP	-6.72	1.19	-5.63	0.00
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	**0.889**		Mean dependent var	7.584
Adjusted R-squared	0.867		S.D. dependent var	2.353
S.E. of regression	0.855		Akaike info criterion	2.678
Sum squared resid	156.030		Schwarz criterion	3.274
Log likelihood	-299.872		Hannan-Quinn criter.	2.918
F-statistic	40.846		Durbin-Watson stat	1.792
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author's Calculation based on World Development Indicators (WDI).

Table 11: Random Effect Model (REM)

Dependent Variable: TOTMORTRAT				
Method: Panel EGLS (Cross-section random effects)				
Sample: 1 256				
Periods included: 8				
Cross-sections included: 32				
Total panel (balanced) observations: 256 Swamy and Arora estimator of component variances				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**

C	25.01	0.95	26.06	0.00
PHE	-0.00	0.00	-6.73	0.00
PRHE	-0.02	0.00	-5.40	0.00
LE	-0.17	0.02	-8.14	0.00
SANITATION	-0.00	0.00	-2.21	0.02
HIV	-0.86	1.05	-0.82	0.41
DPT	-0.04	0.00	-7.71	0.00
GDP	-0.00	0.00	-0.62	0.53
POPAG_0_14	1.62	1.41	1.14	0.25
RURALPOP	-1.64	6.43	-0.25	0.79
URBANPOP	-6.14	1.12	-5.48	0.00
R-squared	**0.870**	Mean dependent var		7.584
Adjusted R-squared	0.864	S.D. dependent var		2.353
S.E. of regression	0.866	Sum squared resid		183.237
F-statistic	148.835	Durbin-Watson stat		1.556
Prob(F-statistic)	**0.000**			

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

Source: Author’s Calculation based on World Development Indicators (WDI).

Table 12: Hausman Test on Random Effect Model

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	36.917	11	0.000

Note: ***, ** and * denote significance at 1 percent, 5 percent and 10 percent levels of significance respectively.

CONCLUSION AND RECOMMENDATIONS

The present article attempts to understand the determinants of health outcomes in the S.A.A.R.C. region. For this, a 33-year panel data is used with ten independent variables (such as public health expenditure, private health expenditure, life expectancy at birth, Sanitation, prevalence of H.I.V., immunization against D.P.T., Gross Domestic Product, population age 0-14, rural population, and urban population) over three outcome variables (infant mortality rate, child mortality rate, and total mortality rate). The panel data set is sourced from World Development Indicators and World Bank reports. The study employed F.E.M. and R.E.M. to check the feasibility, and a Hausman test was applied to all three models. The estimates of all three models show mixed effects over the three outcome variables, such as infant mortality rate, child mortality rate, and total mortality rate, having mixed impacts from their determinants.

Based on the findings, one can conclude that the effects of public expenditure on infant mortality, child mortality, and total mortality are meagre; however, it is statistically significant. Therefore, the study advised that the S.A.A.R.C. nations needed to increase budgetary allocation on health and health care services and facilitate the private sector to become a supplementary partner of the government's mission to cover and provide better health care services to every citizen at minimal and affordable cost.

Similarly, Sanitation also has a meagre effect on all three outcome variables, and it is well known that Sanitation plays an essential role in reducing morbidity and mortality rates. Therefore, it is advised that all the member nations of S.A.A.R.C. focus on an effective sanitation campaign to help reduce all types of mortality in the region.

Life expectancy is another critical determinant of health outcomes, and its relationship with all three outcome variables is negative. This indicates that if life expectancy decreases, infant mortality, child mortality, and total mortality rate go up, and vice versa. Therefore, it is advised that all S.A.A.R.C. nations increase their budgetary allocations for health and healthcare services.

Similarly, the prevalence of H.I.V. plays an essential role in all three outcome variables, and it has a negative relationship with all three outcome variables, especially in child mortality cases. Based on this, the S.A.A.R.C. governments need to focus more and try to reduce the child mortality rate in the region via various favourable policies to curtail the existence of H.I.V.

In this study, the population also plays an important role, especially the rural population, which has a negative relationship with all three outcome variables. This indicates a lack of healthcare access to primary and preventive care medicine in rural areas, socioeconomic conditions, and environmental factors. Therefore, the study advised that the government must take the necessary action to provide at least rudimentary facilities in the region's rural areas.

Similarly, the immunization of D.P.T. has a negative relationship with all three outcome variables; however, it is more effective in reducing child mortality. Therefore, the study advised that the S.A.A.R.C. governments need to cover more areas of the regions with the immunization of D.P.T. to reduce the child mortality rate.

REFERENCES

- Arthur, E., & Oaikhenan, H.E. (2017). The Effects of Health Expenditure on Health Outcomes in Sub-Saharan Africa (SSA). African Development Review, 29, 524-536.
- Bunyaminu, A., Mohammed, I., Yakubu, I.N., Shani, B., & Abukari, A. (2022). The effect of health expenditure on average life expectancy: does government effectiveness play a moderating role? International Journal of Health Governance, Vol. 27 No. 4, pp. 365-377. https://doi.org/10.1108/IJHG-03-2022-0027.
- Grima S, Spiteri JV, Jakovljevic M, Camilleri C and Buttigieg SC (2018) High Out-of-Pocket Health Spending in Countries with a Mediterranean Connection. Front. Public Health 6:145. doi: 10.3389/fpubh.2018.00145.
- Jafrin, N., et.al. (2021). A Panel Data Estimation of the Determinants of Life Expectancy in Selected SAARC Countries, Operations Research and Decisions, No, 4, DOI: 10.37190/ord210404.
- Jain, Y., & Sarma A. (2019). The Analysis of Health Expenditure Determinates in Selected Asian Countries: Does Environmental Externalities Matter for Health Expenditure? International Journal of Economics and Management Vol. 1 Issue (3) pp 51 - 58, 2019, Akkaya Science Publishing.
- Kim, T.K. & Lane, S.R. (2013). Government Health Expenditure and Public Health Outcomes: A Comparative Study among 17 Countries and Implications for US Health Care Reform, Vol. 3 No. 9, American International Journal of Contemporary Research.
- Khan, H.N., Khan, M.A., Razli, R.B. et al. Health Care Expenditure and Economic Growth in SAARC Countries (1995–2012): A Panel Causality Analysis. Applied Research Quality Life 11, 639–661 (2016). https://doi.org/10.1007/s11482-015-9385-z.
- Mohapatra, S., (2023). Health Expenditures, Health Infrastructure and Health Status IN SAARC Countries: A Panel Data Analysis, ISSN: 0256-0909, eISSN: 2395-3799, SAGE Publication, https://doi.org/10.1177/02560909221113382.
- Odhiambo, N.M. (2021). Health expenditure and economic growth in sub-Saharan Africa: An empirical investigation. Development Studies Research, 8(1), pp.73-81, http//doi.org/10.1080/21665095.2021.1892500.
- Rahman, M.M., Alam, K. The nexus between health status and health expenditure, energy consumption and environmental pollution: empirical evidence from SAARC-BIMSTEC regions. BMC Public Health 21, 1694 (2021). https://doi.org/10.1186/s12889-021-11534-w.
- Shaikh, I. & Singh, S. (2016). A Study of Out-of-pocket Health Expenditures: A Case of South Asian Countries. Journal of Health Management. 18. 625-637. 10.1177/0972063416666349.
- Sharma, S. & Bothra, M. (2017). Health Expenditure and its Repercussions on Health Status-An Analysis of South-Asian Countries, International Journal of Current Research, Vol. 9, Issue, 08, pp.55963-55977.
- Singh, S., Bala, M.M., & Kumar, N.S. (2022). The dynamics of public and private health expenditure on health outcome in Southeast Asia. Health & social care in the community, https://doi.org/10.1111/hsc.13698.
- Syeda, H., Khalid, Z., Sajid, Z. & Muhammad, S. (2014). Measuring health expenditures and outcomes in SAARC region: Health is a luxury? Quality & Quantity. 48. 10.1007/s11135-013-9844-2.
- World Development Indicators, (2023)
- World Bank Report, (2023)

***