RESEARCH ARTICLE

Impact of social, demographic, and economic factors on fertility trends in South Asia: Longitudinal analysis based on World Bank and Global Burden of Disease Study 1980-2021

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Abstract

Objective: To investigate the association of socioeconomic factors with total fertility rate in five South Asian countries.

Method: The retrospective, longitudinal study based on secondary data was conducted at the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia, and comprised data from 1980 to 2021 for five South Asian countries, namely, Bangladesh, Bhutan, India, Nepal and Pakistan. Total fertility rates as well as sociodemographic and economic indicators were obtained from multiple authentic sources. Data was analysed using SPSS 29.

Results: The total fertility rate showed a decreasing trend, with the highest decline in Bhutan (78.3%) and the lowest change in Pakistan (48.5%). The total population increased in all the five countries, with the most significant increase in Pakistan (187%), and the smallest in Bhutan (87.2%). The crude death rate declined across the board, with the most prominent being Bhutan (64.1%) and the least prominent being India (31.3%). Life expectancy increased in all the countries, with the most significant change in Bhutan (48.9%), and the least change in Pakistan (14.8%). Gross domestic product per capita increased in all the countries, with the largest increase in Bhutan (1052.1%) and the smallest in Pakistan (413.9%). The results also revealed a consistent directional association between the total fertility rate and multiple sociodemographic indicators across the countries.

Conclusions: Total fertility rates declined alongside improvements in key demographic and economic indicators across South Asia. The observed fertility patterns reflected substantial cross-country heterogeneity, and underscored the complex interplay of social, financial and demographic factors shaping fertility transitions in the region.

Keywords: Fertility, Population, Socioeconomic, Life expectancy, Literacy. (JPMA 76: 924; 2026)

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Introduction

The 21st century is an era of globalisation, technological advancement and rapid population growth; therefore, populations must be regularly studied and monitored to understand the fertility trends. The total fertility rate (TFR) is a key determinant of population growth rates.[1] The assessment of present and future fertility trends and changing population age structures across countries and regions is essential for planning in response to profound socioeconomic, environmental and geopolitical challenges.[2]

The global population is increasing, raising concerns about health, security, biodiversity, climate change and resource allocation.[3] The TFR correlates negatively with education and gross domestic product (GDP) per capita, and positively with religiosity. The growth in GDP per capita and the level of education has a pronounced downward effect on the TFR in most regions. Education for females and economic growth can help achieve sustainable population levels, thereby enhancing overall development and wellbeing. The regional and global fertility statistics are pertinent elements for predicting demographic shifts, whether a population is expected in the future to grow, shrink or stabilize, as it is essential for the estimate of its impact on human resources, economies, the environment and the global climate.[4] These factors eventually affect education and sustainable development. Fertility, alongside migration and mortality, is a key factor influencing population growth, and thus serves as a crucial indicator for policymakers and governments worldwide. The United Nations has predicted that the global population will increase from 7.8 billion in 2020 to 10.9 billion by 2100. However, it has been reported that the global TFR is experiencing an alarming, sharp decline, which is projected to converge to a replacement level by 21001. In the pre-modern era, TFR globally ranged 4.5-7.0

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children per woman, and the decline in TFR began earlier in the Western world before gradually spreading worldwide.[5]

The main factor behind this dramatic global decline in TFR, which began in 1965, is linked to decreasing birth rates due to smaller desired family sizes, education,[6] family planning, and the use of contraception.[7,8] However, despite the extensive evidence and literature on the global decline of TFR, South Asian countries, such as Bangladesh, Bhutan, India, Nepal and Pakistan, still have relatively higher fertility rates than the rest of the world, with population pyramids featuring broad bases and a higher proportion of young people. Factors often cited as contributing to higher TFRs in South Asia include poverty and low literacy levels.[2,9] Nonetheless, further research is necessary to gather convincing evidence in order to enable policymakers to make informed decisions that will benefit the future economies and development of these countries.

The current study was planned to investigate the association of socioeconomic factors with TFR in five South Asian countries.

Materials and Methods

The retrospective, longitudinal study based on secondary data was conducted from June 6 to December 31, 2024, at the Department of Physiology, College of Medicine, King Saud University, Riyadh, Saudi Arabia, and comprised data from 1980 to 2021 for Bangladesh, Bhutan, India, Nepal and Pakistan. Exemption was obtained from the institutional ethics review board regarding informed consent as the data was based on publicly available sources. Data was collected from the Global Burden of Diseases (GBD) study 2024,[2] the World Bank database,[10] the United Nations Development Programme[11] and the Our World in Data database.[12] The GBD is a leading study, updated annually and managed by the Institute for Health Metrics and Evaluation (IHME).[2]

The selected indicators represented key demographic (total population, crude death rate [CDR], life expectancy), social (literacy, urbanisation, affordability of nutrition), and economic (GDP per capita, inflation, human development index [HDI]) domains commonly used to examine fertility dynamics at the population level. The selection was theory-driven rather than data-driven, and no variable screening or selection procedures were applied.

The percentage change was calculated using the observed values at the two specific time points (1980 and 2021) for each country and indicator. The formula used was: (Latest data value for 2021 - Earliest data value available) / Earliest data value available * 100.

The decadal mean and standard deviation for all variables were also calculated for each country, where data was available, to illustrate broader trends over time. Each variable was defined, and its source was identified.

Missing data was managed. With respect to the literacy rate, data was available for only selected years. For example, Bangladesh had values from 1981, 1991, 2001, 2007 and 2011-20; Bhutan from 2005, 2012 and 2017; India from 1981, 1991, 2001, 2006 and 2011; Nepal from 1981, 1991, 2001, 2011 and 2021; and Pakistan from 1981, 1998, 2005-14 and 2017-19. With respect to the unemployment rate, data was available for all countries from 1991 onwards; therefore, the analysis began in 1991. Data related to nutrition was available for all countries from 2017 onwards, and HDI data was available for all countries from 1990 onwards, except for Bhutan for which data was available from 2010 onwards. Data analysis reflected these availability constraints.

Data was analysed using SPSS 29. Data was presented as frequencies and percentages, or as mean±standard deviation for all variables in each country, Mean values were also calculated for 10-year periods. They were also calculated for two periods, 1980-2000 and 2001-21, to facilitate short-term trend analysis. This was followed by a percentage change of the total 40-year period from 1980 to 2021. Data normality was assessed using graphical methods, like histograms and Q-Q plots, and the Shapiro-Wilk test. Because most variables did not meet the assumptions of normality, Spearman's rank correlation coefficient was used to examine associations between fertility rates and the independent variables. $P<0.05$ was considered statistically significant. Given the exploratory and descriptive nature of the analysis, no multivariable adjustment was performed to account for potential confounding effect or multicollinearity among sociodemographic variables. Moreover, because several variables and the TFR followed consistent monotonic trends over time, Spearman's rank correlation occasionally produced near-perfect coefficients. These values reflected shared temporal patterns and limited observation points for specific indicators rather than authentic one-to-one relationships.

Results

TFR showed a decreasing trend, with the highest decline in Bhutan (78.3%) and the lowest change in Pakistan (48.5%) (Figure 1). The total population increased in all the five countries, with the most significant increase in Pakistan (187%), and the smallest in Bhutan (87.2%). The CDR declined across the board, with the most prominent being Bhutan (64.1%) and the least prominent being India

Table-1: Descriptive analysis of total fertility rate (TFR) and sociodemographic variables.

Variables	Country	Mean ±SD		% change
		1980-2001	2001-2021	1980 to 2021
Total Fertility Rate (#)[13]	Bangladesh	4.6±1.14	2.4±0.44	-68.7
	Bhutan	5.3±1.03	2.2±0.62	-78.3
	India	4.0±0.51	2.6±0.43	-57.5
	Nepal	5.1±0.52	2.6±0.48	-64.0
	Pakistan	6.2±0.51	4.2±0.50	-48.5
Total Population (#)[14]	Bangladesh	106772741±13849689.92	150808518±11282329.32	101.4
	Bhutan	515461± 48948.91	706974±52036.91	87.2
	India	873200644±113322302.02	1253376589±102891204.42	102.4
	Nepal	19891697±2861313.82	37256258±1276359.82	92.3
	Pakistan	115830653±22527942.51	196275110±22139731.31	187.0
Crude Death Rate (#)[15]	Bangladesh	11.6±2.82	6.1±0.51	-63.5
	Bhutan	1.9±2.73	7.0±0.39	-64.1
	India	10.9±1.61	7.4± 0.58	-31.3
	Nepal	12.7±3.00	7.1±0.28	-53.6
	Pakistan	10.7±0.87	7.6±0.58	-40.5
Life Expectancy (years)[16]	Bangladesh	57.0±4.37	69.1±2.32	39.8
	Bhutan	55.8±4.49	68.3±2.59	48.9
	India	58.4±2.67	67±2.48	25.4
	Nepal	55.1±4.91	66.9±1.91	42.8
	Pakistan	59.8±1.12	64.6±1.42	14.8
Literacy rate (%)[17]	Bangladesh	32.3±4.31	63.9±10.21	153.8
	Bhutan	-	58.2±7.39	-
	India	44.5±5.22	64.4±4.43	87.5
	Nepal	26.8±8.81	59.8±11.31	246.3
	Pakistan	34.2±12.01	55.4±2.39	144.4
Unemployment (%)[18]	Bangladesh	2.6±0.39	4.3±0.52	-
	Bhutan	1.4±0.10	3.0±0.91	-
	India	7.2±0.42	8.0±0.59	-
	Nepal	10.6±0.00	10.9±0.65	-
	Pakistan	0.6±0.00	2.2±1.86	-
Urbanisation (%)[19]	Bangladesh	19.6±2.61	31.3±4.61	160.0
	Bhutan	16.9±4.81	35.3±5.02	330.0
	India	25.5±1.39	31.4±2.31	52.2
	Nepal	9.2±2.24	17.2±2.19	250.0
	Pakistan	30.6±1.52	35.2±1.28	32.1
Inability to afford Nutrition (%)[20]				
	Bangladesh	-	37.2±8.48	-
	Bhutan	-	37.1±8.48	-
	India	-	73.7±3.32	-
	Nepal	-	75.6±3.41	-
	Pakistan	-	81.0±1.32	-
GDP per capita (current USD)[21]				
	Bangladesh	288.4±72.81	1080.3± 677.41	1037.5
	Bhutan	475.0±128.69	2201.2± 944.72	1052.1
	India	341.0±56.32	1303.9±563.14	738.2
	Nepal	176.1±27.00	681.1±348.92	891.1
	Pakistan	385.4±78.00	1133.4±319.18	413.9
Inflation[22]	Bangladesh	8.5±3.72	6.3±1.82	-45.0
	Bhutan	8.8±2.11	5.5±2.31	-27.0
	India	9.1±2.78	6.4±2.62	-54.9
	Nepal	9.9± 4.00	6.5±2.84	-72.1
	Pakistan	8.4± 3.12	7.8±4.12	-20.2
Human Development Index (HDI)[11]				
	Bangladesh	0.4± 0.03	0.6±0.05	-
	Bhutan	-	0.6±0.03	-
	India	0.5± 0.02	0.6±0.05	-
	Nepal	0.4±0.02	0.5±0.04	-
	Pakistan	0.4±0.01	0.5±0.03	-

NB: "Unemployment (%)," "Inability to afford Nutrition (%)," and "HDI" have unavailable data from 1980 -1990, and therefore, data for the 40-year % change from 1980 to 2021 could not be calculated.
GDP: Gross domestic product. USD: United States dollar.

Table-2: Correlation between total fertility rate (TFR) and sociodemographic variables.

Country	TFR rate x Variable	Correlation coefficient	2-tailed significance level
Bangladesh	TFR x Total Population	- 1.000**	<0.01
	TFR x Crude Death Rate	0.980**	<0.01
	TFR x Life Expectancy	-0.993**	<0.01
	TFR x Literacy rate	-0.991**	<0.01
	TFR x Unemployment	-0.881**	<0.01
	TFR x Urbanisation (%)	-1.000**	<0.01
	TFR x Inability to afford Nutrition	0.205	0.74
	TFR x Gross domestic product (GDP) per capita	-0.993**	<0.01
	TFR x Inflation	0.518**	<0.01
	TFR x Human Development Index (HDI)	-1.000**	<0.01
Bhutan	TFR x Total Population	-0.982**	<0.01
	TFR x Crude Death Rate	0.983**	<0.01
	TFR x Life Expectancy	-1.000**	<0.01
	TFR x Literacy rate	-1.000**	<0.01
	TFR x Unemployment	-0.823**	<0.01
	TFR x Urbanization (%)	-1.000**	<0.01
	TFR x Inability to afford Nutrition	0.300	0.62
	TFR x GDP per capita	-0.988**	<0.01
	TFR x Inflation	0.504**	<0.01
	TFR x Human Development Index (HDI)	-1.000**	<0.01
India	TFR x Total Population	-1.000**	<0.01
	TFR x Crude Death Rate	0.990**	<0.01
	TFR x Life Expectancy	-0.990**	<0.01
	TFR x Literacy rate	-1.000**	<0.01
	TFR x Unemployment	-0.215	0.25
	TFR x Urbanization (%)	-1.000**	<0.01
	TFR x Inability to afford Nutrition	0.500	0.40
	TFR x GDP per capita	-0.986**	<0.01
	TFR x Inflation	0.423**	<0.01
	TFR x Human Development Index (HDI)	-0.996**	<0.01
Nepal	TFR x Total Population	-1.000**	<0.01
	TFR x Crude Death Rate	0.936**	<0.01
	TFR x Life Expectancy	-.996**	<0.01
	TFR x Literacy rate	-1.000**	<0.01
	TFR x Unemployment	-.425*	0.02
	TFR x Urbanization (%)	-1.000**	<0.01
	TFR x Inability to afford Nutrition	1.000**	<0.01
	TFR x GDP per capita	-.994**	<0.01
	TFR x Inflation	0.408**	<0.01
	TFR x Human Development Index (HDI)	-0.999**	<0.01
Pakistan	TFR x Total Population	-1.000**	<0.01
	TFR x Crude Death Rate	0.997**	<0.01
	TFR x Life Expectancy	-.991**	<0.01
	TFR x Literacy rate	-.947**	<0.01
	TFR x Unemployment	-.627**	<0.01
	TFR x Urbanization (%)	-1.000**	<0.01
	TFR x Inability to afford Nutrition	-0.200	0.75
	TFR x GDP per capita	-.981**	<0.01
	TFR x Inflation	0.094	0.56
	TFR x Human Development Index (HDI)	-0.999**	<0.01

NB:

- Sample size (n) represents the number of years with paired data available for each variable and varied across correlation pairs due to differences in data availability. Across analyses, n ranged 5-41 years.
- A negative/inverse correlation indicates the increase in one variable with a decrease in the other variable. A positive correlation suggests an increase/decrease of both variables in the same direction.
- Near-perfect Spearman coefficients reflect shared monotonic time trends and limited observation points for certain indicators and should be interpreted as directional associations rather than exact effect sizes.
- **Correlation significant at $p<0.01$ (2-tailed), *$p<0.05$ level (2-tailed).

(31.3%). Life expectancy increased in all the countries, with the most significant change in Bhutan (48.9%), and the least change in Pakistan (14.8%). GDP per capita increased in all the countries, with the largest increase in Bhutan (1052.1%) and the smallest in Pakistan (413.9%) (Table 1) Social variables changed significantly across all countries (Figures 2-4).

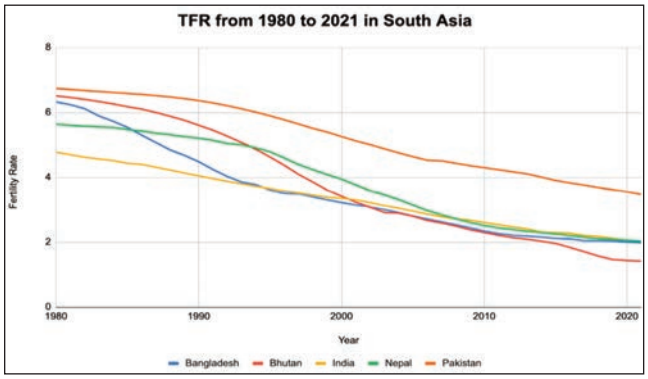

Figure1: Total fertility rate (TFR) trend between 1980 and 2021 in five South Asian countries

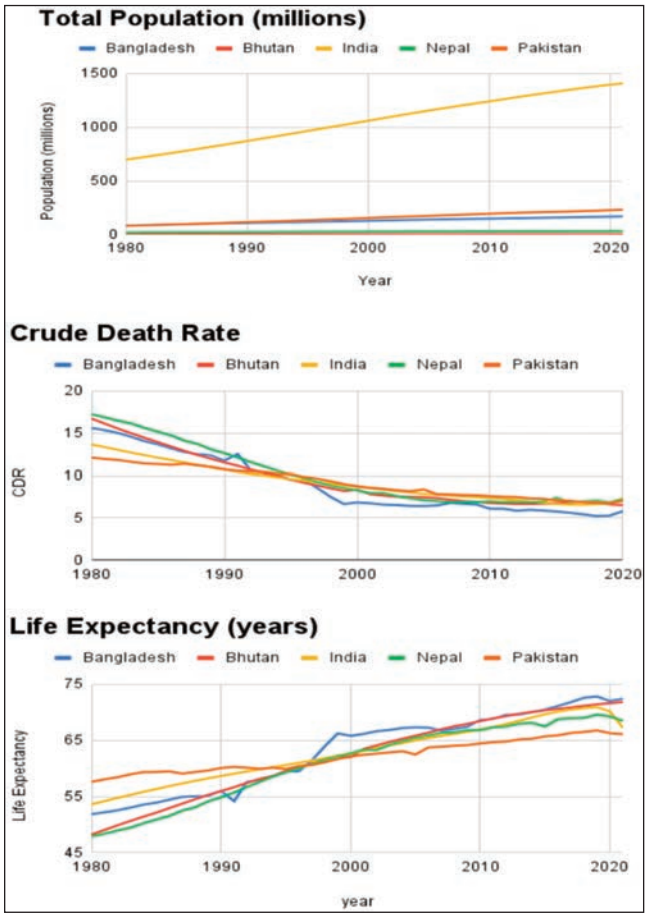

Figure-2: Demographic trends in South Asia from 1980 to 2021.

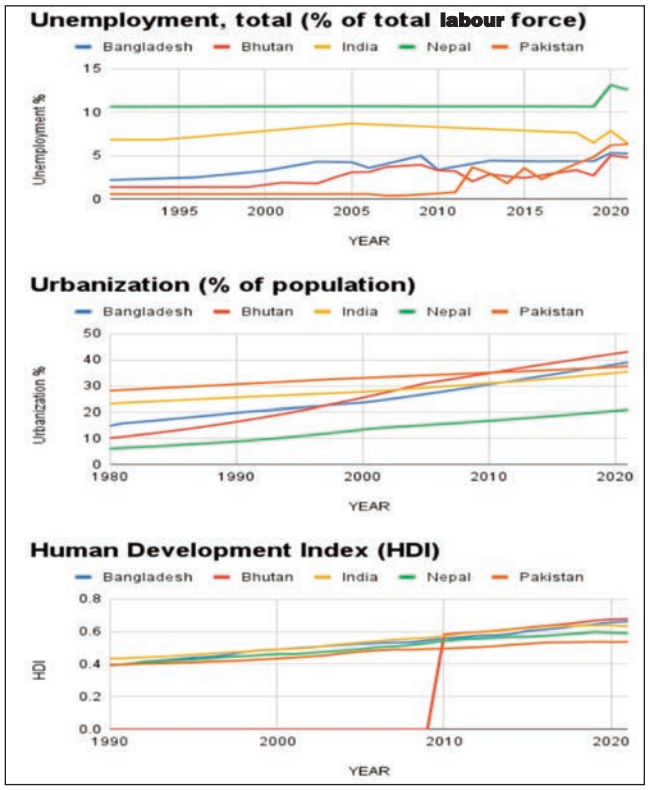

Figure-3: Social trends in South Asia from 1980 to 2021.

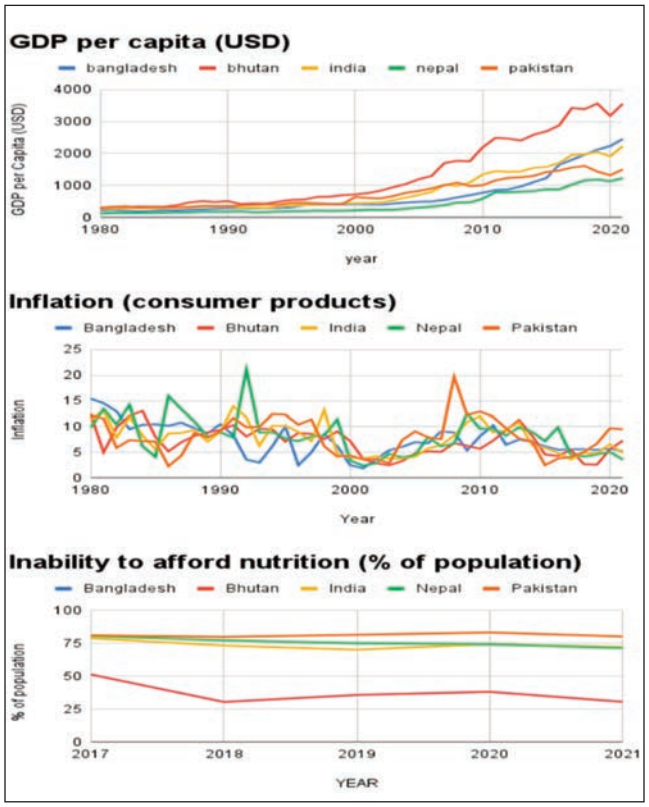

Figure-4: Economic trends in South Asia from 1980 to 2021.

Correlational analysis for TFR with 10 sociodemographic variables across the five countries demonstrated significant monotonic relationships with over time, with most indicators showing an inverse association with TFR, but CDR, inflation and the affordability of nutrition exhibiting positive association (Table 2).

Discussion

Recent literature indicates a global decline in TFRs.[2] Consistent with such findings, the current study demonstrated marked country-level variation in fertility trends across South Asia. There are multiple contributing factors for the fatality trends; empowerment-related factors have played a major role.[23,24] The TFR trend showed a decreasing trend in all the five South Asian countries analysed, and the same was the case with CDR. However, life expectancy, literacy rate, unemployment and GDP per capita increased. Most sociodemographic variables showed an inverse association with TFR over time, whereas CDR, inflation and nutritional affordability showed a positive association. Also, periods of higher CDR, inflation and reduced nutritional affordability coincided with higher fertility rates in the current study.

In the global context, studies from Europe and other regions provide mixed evidence on the determinants of fertility decline. Galor et al. in 2012[25] reported a weak association between economic development and TFR, identifying education as a more influential factor. Other studies have highlighted the roles of race, residence, education, women's employment, marriage age, contraceptive use, and economic conditions in shaping fertility patterns.[26] Song et al.[27] further emphasised that women's perceptions of marriage and children may exert a more substantial influence on fertility than income or employment status. Although these studies differ in focus, findings on the relationship of economic, educational and health factors with TFR remain inconsistent.[26,27] More recent evidence suggests that declining TFRs are associated with GDP per capita, life expectancy, female education, and HDI, with slight fertility rebounds observed in parts of Western and Eastern Europe.[28]

In South Asia, declining fertility rates appear to be linked to factors such as rapid economic growth, education, urbanisation, and improvements in healthcare systems. As countries undergo demographic transition and shift from agrarian to industrial economies, demand for smaller family sizes increases due to changing lifestyle preferences and economic pressures. Additionally, access to education, particularly for women, plays a critical role in fertility decisions. Higher levels of education are often associated with delayed marriage and childbearing, as well as increased awareness and use of family planning methods. Moreover, economic opportunities for women outside the household can empower them to make autonomous decisions regarding their reproductive choices, further influencing fertility rates.[3,24]

Within South Asia, fertility transitions have been heterogeneous. Although all the five countries experienced declining TFRs, the pace and magnitude of the decline varied substantially. Pakistan exhibited a slower decline, coinciding with lower female educational attainment, uneven access to family planning, and persistent sociocultural norms favouring larger families. In contrast, Bhutan, Bangladesh and Nepal experienced more pronounced reductions in fertility alongside improvements in education, health indicators and economic conditions. These differences underscore that fertility transitions are shaped by interactions among structural, social and institutional factors rather than by a single determinant. Education remains a central driver of fertility decline, although its influence is moderated by broader cultural and societal contexts, underscoring the importance of integrated health, education and economic frameworks.[29]

However, it is also evident that, while there has been a global decline in TFR, the South Asian decline is smaller and may be linked to the fact that in some societies, economic growth and literacy do not reduce TFR due to established cultural or religious norms that support larger families. Understanding the underlying factors driving these differences is crucial for policymakers and researchers to formulate effective policies that promote sustainable population growth and development.

Another theory that can further explain this shift in the population pyramid is the Demographic Transition Theory, which posits a global reduction in mortality rates due to improved health and control over infectious diseases, accompanied by a simultaneous decrease in TFR, as modernisation has made children being perceived as a costly option. This, alongside the empowerment of women to make their own reproductive decisions, is leading to smaller families, with a focus on the quality of children rather than their quantity.[30]

Overall, fertility rates are declining gradually globally. Global estimates indicate that TFRs declined from approximately 4.8 births per woman in 1950 to 2.2 births per woman in 2021. Fertility rates have varied dramatically across regions, influenced by factors such as wealth, education and sociocultural behaviours and practices.[2]

The current study has several limitations. First, missing data for some key variables limited data completeness and may

have introduced bias. Data availability varied across countries and years, leading to the exclusion of certain countries (e.g., Sri Lanka) and time periods, which may have influenced the observed trends and correlations. Second, the use of national-level aggregate data may mask significant subnational and regional variations within countries, as fertility patterns and socioeconomic conditions often differ substantially between rural and urban settings. Future studies using disaggregated regional or subnational data could provide more granular insights. Third, cultural, political and societal determinants of fertility, such as social norms, religious beliefs, gender roles, and marriage practices, were not explicitly included due to data unavailability, despite their known influence on reproductive behaviour. Incorporating qualitative or mixed-method approaches in future research may help capture these contextual influences more comprehensively. Fourth, the analysis relied on bivariate Spearman correlation coefficients, and did not adjust for potential confounding factors or multicollinearity among sociodemographic indicators. Several variables examined, such as education, GDP per capita, urbanisation and life expectancy, are inherently interrelated and may reflect shared structural and temporal trends. Consequently, the magnitude of observed associations may be inflated, and the findings should be interpreted as descriptive and exploratory rather than as estimates of independent or causal effects. Finally, given the correlational and ecological nature of the study, causal inferences cannot be drawn.

Despite these limitations, however, the current findings were based on multiple, high-quality international data sources and a long observation period (1980-2021), providing a comprehensive overview of fertility trends and associated sociodemographic patterns across South Asia. The current findings highlighted the need for strengthened female education beyond government-led efforts, supported through public-private collaboration. Addressing fertility dynamics in South Asia requires a multidimensional approach that integrates social, demographic and economic factors while respecting cultural diversity. Promoting female education, family planning awareness, and culturally sensitive engagement is essential for policy acceptance. Enforcement of laws against child marriage, alongside improved access to education and healthcare, remains critical. A holistic and culturally informed strategy can support sustainable fertility management and improved quality of life in the region.

Conclusion

TFRs declined across all the five South Asian countries studied, with the most significant reduction observed in Bhutan, and the smallest in Pakistan. Concurrently, CDRs declined, while life expectancy, literacy and GDP per capita increased, albeit to varying degrees. Most sociodemographic indicators showed inverse associations with fertility, whereas CDR, inflation and nutritional affordability were positively associated with fertility.

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SAM, ASM, NS, FA & SA: Concept, research design, data collection, data analysis, writing, editing, final approval and agreement to be accountable for all aspects of the work.