MITTAL SCHOOL OF BUSINESS

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Course Code: QTTM509	**Course title: Research Methodology - I**
Academic Task No. 2	**Academic task title: A Comparative Statistical Study of Life Expectancy, Health Expenditure and Socio-Economic Indicators in India, China**
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Evaluation parameters:	

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Evaluator's comments

General observations	Suggestions improvement	Best part of assignment

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DECLARATION

We hereby declare that the **Research Methodology** project entitled **"A Comparative Statistical Study of Life Expectancy, Health Expenditure and Socio-Economic Indicators in India, China and the United States (2019–2023)"** submitted to **Lovely Professional University**, is our original work carried out as a group for the **Continuous Assessment (CA-2)** of **Research Methodology I (QTTM509)**.

We confirm that the data used in this project has been collected from appropriate secondary sources and that the analysis, findings, interpretations, and recommendations presented in the report are based on our group's work.

We further declare that this project has not been submitted to any other institution or university for any other academic purpose.

We also declare that any use of AI tools in preparing this report was limited to language polishing and improvement of presentation, in accordance with the assignment guidelines.

Group member confirmation

Student 1: ___**Prem Raj**

Student 2: ___ **Ram Arora**

Student 3: ___ **Manav Rana**

Student 4: ____ **Khushi**

PEER ASSESSMENT

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B	12604430	Q1P2641	RQ1P2641B53	Prem Raj	9

Table Of Content
1. Introduction
2. Review of Literature
3. Research Methodology
4. Data & Statistical Analysis
5. Findings & Conclusion
6. Managerial Implication
7. References

1. Introduction

1.1 Background

1.1 Background Life expectancy at birth is one of the most widely used summary measures of a nation's development. It condenses the effects of income, nutrition, sanitation, education and, above all, the quality and reach of the health system into a single number: the years a newborn would live if today's age-specific death rates continued throughout life. Because it is comparable across countries and over time, it is used by the United Nations, the World Bank and national governments to judge whether economic progress is turning into human well-being.

A natural policy question follows: does spending more on health actually make people live longer? Governments around the world are raising health budgets, but the evidence on how much extra life each additional dollar buys is mixed, and the COVID-19 pandemic showed that even rich health systems can lose years of life in a short period.

1.2 Why India, China and the United States

The three countries give a sharp test of the question because they sit at very different points of health spending. The United States spends the most on health in the world, about 16.7% of GDP and roughly US$13,473 per person in 2023, yet its life expectancy (78.4 years) is still below its 2019 level. China has expanded its health system rapidly, with per-capita spending rising from US$539 to US$763 between 2019 and 2023. India spends the least, about US$85 per person (3.3% of GDP) in 2023, but its life expectancy recovered strongly after the pandemic, reaching 72.0 years. India and China together hold roughly a third of the world's population, so what happens in these two countries matters globally.

1.3 Problem statement

Health spending, income and life expectancy all tend to rise together, but it is unclear how strong the link is, whether it is similar across countries at different spending levels, and whether it held during the 2020–2021 pandemic shock. This study asks: how are health expenditure and other socio-economic indicators related to life expectancy in India, China and the United States between 2019 and 2023, and what can be expected over the next five years?

1.4 Significance of the study

- **For policy makers:** shows how much additional life is associated with higher health spending, and where returns diminish.
- **For comparison:** places a low-, a middle- and a high-spending economy in one consistent framework.

- **For students of quantitative methods:** demonstrates descriptive statistics, correlation, regression, index numbers and forecasting on one real dataset.

1.5 Scope and structure

- **Countries:** India, China and the United States.
- **Period:** 2019–2023, annual data (5 years × 3 countries = 15 observations), covering the pre-pandemic year, the COVID-19 shock (2020–2021) and the recovery (2022–2023).
- **Data and variables:** 12 World Bank World Development Indicators covering health, income, mortality, fertility and urbanisation.

2. Review of Literature

2.1 Summary of existing studies

A. Income, Economic Development and Life Expectancy

1. Preston (1975), "The Changing Relation between Mortality and Level of Economic Development," Population Studies. Preston observed that richer countries have a higher life expectancy, but that the correlation becomes weaker with higher income levels. Moreover, greater health education and advancements in technology result in higher life expectancy, even without an increase in income levels.

2.Anand, S. & Ravallion, M. (1993). Human development in poor countries: on the role of private incomes and public services, Journal of Economic Perspectives. This study found that income affects health primarily through enabling the government to spend more on healthcare and anti-poverty initiatives. Public services play a key role in determining longevity, not income alone.

3. Pritchett & Summers, "Wealthier Is Healthier," Journal of Human Resources (1996). These scholars found that wealth leads to good health outcomes, especially for children. They showed that development is the most powerful driver of population health.

4. Deaton (2003): "Health, Inequality, and Economic Development," Journal of Economic Literature. This review article described the relationship between health, income and inequality. The author noted that the relationship is complex in nature because health influences income and vice versa.

5. Shaw, Horrice and Vogel (2005) "Determinants of Life Expectancy: Analysis of the Health Data of OECD." In this study conducted on OECD member countries, it is found that income, health expenditure and lifestyle are correlated with life expectancy. It indicates that there is no one single variable which can explain difference in life expectancies among countries.

B. Healthcare Spending and Health Outcomes

6. Hitiris and Posnett, "The Determinants and Effects of Health Expenditure in Developed Countries," Journal of Health Economics, 1992. In this study, the authors have used 20 OECD countries as their sample to demonstrate the relationship between health expenditure and GDP per capita. Health expenditure was found to positively impact health outcomes.

7. Filmer and Pritchett (1999), “The Impact of Public Spending on Health: Does Money Matter?” Social Science & Medicine. Their study shows that government expenditure on health alone has a very little impact on reducing child mortality. Income, education, and efficiency of expenditure are the other important factors.

8. Or (2000), “Determinants of Health Outcomes in Industrialised Countries: A Pooled, Cross-Country, Time Series Analysis,” OECD Economic Studies. It was shown that greater health expenditure is associated with lower rates of premature mortality in advanced economies. Both income level and lifestyle have contributed to the outcomes.

9. Nixon and Ulmann (2006), “The Relationship between Health Care Expenditure and Health Outcomes,” European Journal of Health Economics. The authors have analyzed EU countries over time and found out that greater health expenditure is associated with higher infant mortality and life expectancy rates.

10. Bokhari, Gai and Gottret (2007): "Government Health Expenditures and Health Outcomes." Health Economics. According to this research, the government health expenditure is able to decrease child mortality rates and mortality of children under 5. The influence is bigger for poor countries and effective management of the spending.

11. Rajkumar and Swaroop (2008): "Public Spending and Outcomes: Does Governance Matter?" Journal of Development Economics. The researchers found out that the better the governance, the more efficient the public spending in health area can be. Increased amount of money cannot influence the result if there is no good governance.

12. Gallet and Doucouliagos (2017): "The Impact of Healthcare Spending on Health Outcomes: A Meta-Regression Analysis." Social Science & Medicine. This paper analyzes multiple studies and finds that the healthcare spending has a positive influence on health outcomes although it is small.

C. Studies on India, China and the United States

13. Dandona et al. (2017), "Nations within a Nation: Variations in Epidemiological Transition across the States of India, 1990-2016," The Lancet. In this article, the authors demonstrated the variations in health outcomes and disease profiles among Indian states. Thus, there is considerable heterogeneity in the health situation in one country.

14. Zhou et al. (2019), "Mortality, Morbidity, and Risk Factors in China and Its Provinces, 1990-2017," The Lancet. In this research, the authors reported an impressive improvement in life expectancy in China during the analyzed period, accompanied by important transformations in disease profiles. Moreover, it was shown that non-communicable diseases have become the major public health concern.

15. Chetty et al. (2016), "The Association between Income and Life Expectancy in the United States, 2001-2014," JAMA. In the article, the authors have discovered large disparities in life expectancy between the highest and lowest-income Americans. Even in the country with high economic development, income is a strong predictor of people's longevity.
16. Woolf and Schoomaker (2019), "Life Expectancy and Mortality Rates in the United States, 1959-2017," JAMA. The authors of the paper have described the halt in improvement of life expectancy in the US recently. The authors associate this phenomenon with increased

2.2 Research Gaps (RG)

Reading across these studies, the following gaps motivate the present work:

1. Few direct three-economy comparisons. Most studies pool dozens of countries in a single panel.

Comparing a low-spending (India), a middle-spending (China) and a high-spending (United States) economy in the same framework is less common, even though together they cover very different development stages.

2. Share of GDP versus spending per person. Health expenditure is measured both as a percentage of GDP and in US$ per capita, and they can tell different stories (for India, the share of GDP fell while per-capita spending rose). Studies rarely compare both measures on the same data.

3. The COVID-19 shock and recovery. Life expectancy fell sharply in 2020–2021 in India and the

United States and then recovered. Few comparative studies examine, in one framework, how

spending and life expectancy moved before, during and after the pandemic, using data up to 2023.

4. Single-technique analysis. Many papers rely on regression alone. Few combine descriptive

statistics, correlation, regression, index numbers and a short-term forecast in one coherent,

reproducible design.

5. Handling of multicollinearity. Income, health spending and urbanisation are highly correlated, and

this problem is often not tested (for example with variance inflation factors).

2.3 Research Objectives (RO)

The main objective is to examine how health expenditure and related indicators are associated with life

expectancy in India, China and the United States over 2019–2023. It is divided into five specific objectives,

each linked to a statistical tool

No.	Specific objective	Tool used	Section
RO1	To describe and compare the central tendency (mean, median, mode) and variability of life expectancy and 11 related indicators in the three countries.	Descriptive statistics	4.1
RO2	To measure the strength and direction of the relationship between life expectancy and health expenditure, income, mortality and demographic variables.	Correlation analysis	4.2
RO3	To estimate how much of the variation in life expectancy is explained by health expenditure.	Simple and multiple regression	4.3
RO4	To compare the change in life expectancy, income, health spending and infant mortality across the countries (base year 2019 = 100).	Index numbers	4.4
RO5	To forecast life expectancy for 2024–2028 in each country.	Trend forecasting	4.5

2.4 Research Hypotheses (RH)

The hypotheses follow from the literature: health spending and income are expected to raise life expectancy (Preston, 1975; Nixon & Ulmann, 2006), and child mortality is expected to move in the opposite, direction because early-life deaths lower average life expectancy. Each hypothesis is stated in null (H_0) and alternative (H_1) form and tested at the 5% level of significance.

No.	Null hypothesis (H_0)	Alternative hypothesis (H_1)	Test	Objective
H1	There is no significant correlation between health expenditure per capita and life expectancy ($\rho = 0$).	Health expenditure per capita and life expectancy are significantly positively correlated ($\rho > 0$).	Pearson r, t-test	RO2
H2	There is no significant correlation between health expenditure (% of GDP) and life expectancy.	The two are significantly positively correlated.	Pearson r, t-test	RO2
H3	There is no significant correlation between GDP per capita and life expectancy.	The two are significantly positively correlated.	Pearson r, t-test	RO2
H4	There is no significant correlation between infant mortality and life expectancy.	Infant mortality and life expectancy are significantly negatively correlated ($\rho < 0$).	Pearson r, t-test	RO2
H5	Health expenditure per capita has no significant effect on life expectancy after controlling for fertility rate and GDP growth ($\beta = 0$).	Health expenditure per capita has a significant effect on life expectancy ($\beta \neq 0$).	Regression t and F tests	RO3

3. Research Methodology

3.1 Research design

The study is quantitative, descriptive and explanatory, using secondary panel data (3 countries × 5 years). The descriptive part summarises each country; the explanatory part tests relationships and estimates a regression model. Analysis was carried out in Python (pandas, SciPy, Matplotlib), and all results can be reproduced from the Excel dataset.

3.2 Data source and sample

Data come from the World Bank World Development Indicators (WDI), retrieved through the official API on 9 October 2026. The extract covers 2000–2023 (72 observations); this study uses the 2019–2023 subset, giving 15 country-year observations with no missing values and no duplicate records, as confirmed in the data-quality report. Health-expenditure series are compiled by the WHO and may be

provisional for 2022–2023, and life expectancy and mortality for 2020–2022 reflect the COVID-19 period.

The data licence is CC BY 4.0.

3.3 List of variables

Table 1: *Variables used in the study (definition, source, relevance, dataset code and tools/tests)*

Variable	Definition	Source	Relevance	Tool / test used
Life Expectancy at Birth	Years a newborn would live if current mortality patterns persisted	UN Population Division	Dependent variable: overall population health outcome	Descriptive stats, correlation, regression, index no., forecast
Health Exp. (% of GDP)	Current health spending as a share of GDP	WHO Global Health Expenditure Database	Measures priority given to health in the economy	Correlation, regression (Model 1)
Health Exp. per Capita	Current health spending per person, current US$	WHO Global Health Expenditure Database	Main independent variable: resources per person	Correlation, regression (Models 2–3), index no.
GDP per Capita	GDP divided by mid-year population, current US$	World Bank national accounts	Income level, the key driver in the Preston curve	Correlation, index no.
GDP Growth	Annual % growth of real GDP (constant prices)	World Bank national accounts	Captures short-run economic performance	Correlation, regression control
Infant Mortality Rate	Infant deaths before age 1 per 1,000 live births	UN IGME	Sensitive indicator of health-system quality	Correlation, index no.
Under-5 Mortality Rate	Probability of dying before age 5 per 1,000 births	UN IGME	Child survival; strongly tied to longevity	Correlation
Fertility Rate	Births per woman over her reproductive life	UN Population Division	Demographic transition stage; regression control	Correlation, regression control
Population Growth	Annual % growth of mid-year population	UN Population Division	Population pressure on health resources	Correlation
Urban Population (%)	Share of people living in urban areas	UN World Urbanization Prospects	Access to services and infrastructure	Correlation
Birth Rate	Live births per 1,000 population	UN Population Division	Age structure of the population	Correlation
Death Rate	Deaths per 1,000 population	UN Population Division	Crude mortality; affected by age structure	Correlation

3.4 Statistical tools and tests

Tool	Purpose	Test / measure
Descriptive statistics	Summarise and compare each country	Mean, median, mode, standard deviation, minimum, maximum, coefficient of variation, skewness
Correlation analysis	Strength and direction of association	Pearson r (with t-test for significance), Spearman ρ as a robustness check
Regression analysis	Estimate effect of health spending on life expectancy	OLS; t-test, F-test, R^2, adjusted R^2, standard error, VIF, Durbin–Watson
Index numbers	Compare change across countries on a common scale	Simple (fixed-base) index, base year 2019 = 100; average annual change
Forecasting	Project life expectancy for 2024–2028	Linear trend (least squares) and a no-change benchmark (2023 level held constant)

3.5 Limitations

• The sample is small (three countries, 15 observations; only 5 per country), so results describe these countries and should not be generalised. Within-country correlations were not computed because 5 points are too few to be reliable.

• Pooled correlations mix differences between countries with changes over time within each country; both views are therefore reported.

• Correlation and regression show association, not proof of causation. A third factor such as education or nutrition can drive both spending and longevity.

• Observations within each country are time-ordered, so errors are autocorrelated (low Durbin– Watson), which makes standard errors optimistic.

• Spending is in current US$, not adjusted for purchasing power or inflation, which exaggerates the gap between India and the USA.

4. Data and Statistical Analysis

4.1 Descriptive statistics

Tables 2–5 give the descriptive statistics for each country. The mode of a continuous variable is rarely meaningful, so it is computed after rounding values to one decimal place (to the nearest whole number for variables above 100); where no value repeats, the first value is shown.

Table 2: *Descriptive statistics, India*

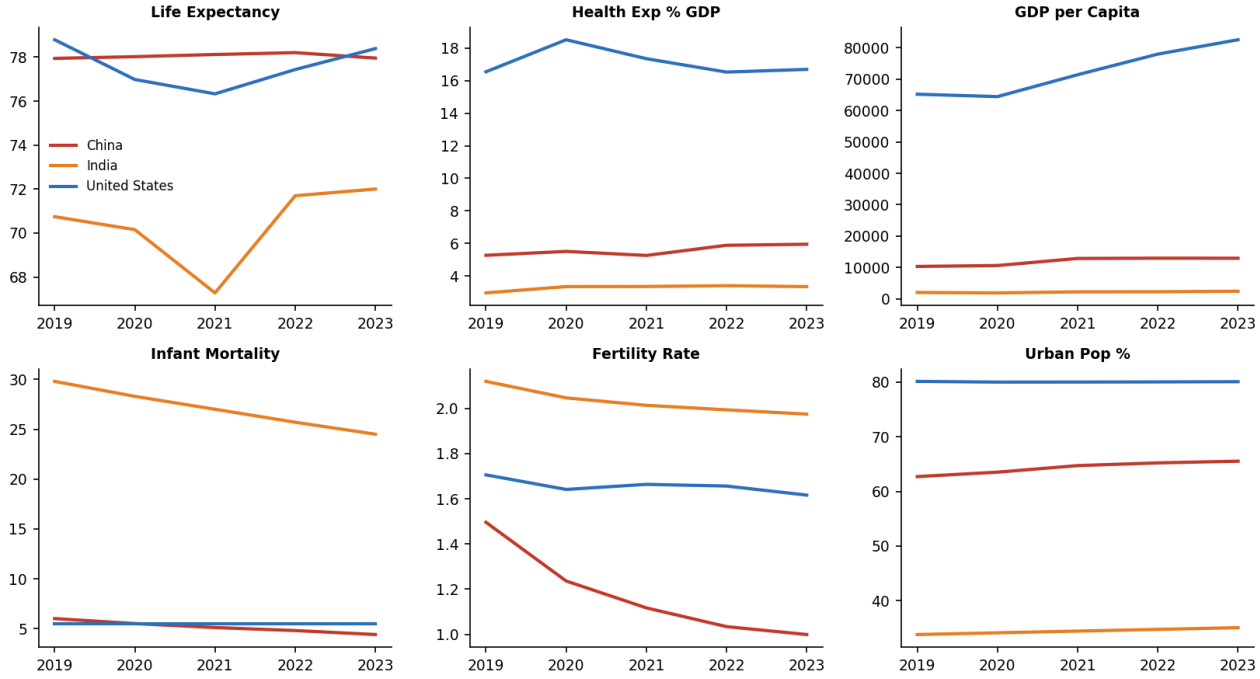
INDIA					
VARIABLE	MEAN	MEDIAN	STD.DEVIATION	MIN	MAX
Life Expectancy	70.38	70.75	1.682435378	67.28	72.00
GDP per Capita	2,180.50	2,239.61	185.47	1,907.04	2,434.45
Health Expenditure (% GDP)	3.28	3.34	0.16	2.95	3.40
Infant Mortality Rate	27.06	27.00	1.87	24.50	29.80
Urban Population (%)	34.44	34.44	0.44	33.81	35.07

Table 4: *Descriptive statistics, United States*

USA					
VARIABLE	MEAN	MEDIAN	STD.DEVIATION	MIN	MAX
Life Expectancy	77.58	77.43	0.9002629	76.33	78.79
GDP per Capita	2.42	71,441.23	7078.56413	64,465.30	82,586.78
Health Expenditure (% GDP)	17.13	16.69	0.756842919	16.53	18.52
Infant Mortality Rate	5.50	5.50	0	5.50	5.50
Urban Population (%)	80.05	80.03	0.05	80.00	80.13

Table 5: *Descriptive statistics, United States*

CHINA					
VARIABLE	MEAN	MEDIAN	STD.DEVIATION	MIN	MAX
Life Expectancy	78.05	78.02	0.0999908	77.94	78.20
GDP per Capita	11,955.92	12,887.44	1204.530928	10,342.90	12,970.61
Health Expenditure (% GDP)	5.57	5.50	0.29402778	5.26	5.94
Infant Mortality Rate	5.16	5.1	0.5535341	4.4	6
Urban Population (%)	64.34	64.72	1.063567865	62.71	65.53



Interpretation: Life expectancy in China is flat. India falls to its lowest point in 2021 and rises above its 2019 level by 2023, and the United States falls in 2020–2021 and is still below its 2019 level in 2023.

Infant mortality fell in India and China and stayed constant in the United States. Health spending (% of GDP) is more than three times higher in the United States than in the other two countries.

4.2 Correlation analysis

Pearson correlation coefficients were computed between every pair of variables (n = 15). Figure 5 shows the full matrix and Table 6 shows each variable's correlation with life expectancy, along with the Spearman rank correlation as a robustness chec

Figure 5: *Correlation matrix of all 12 variables (Pearson r)*

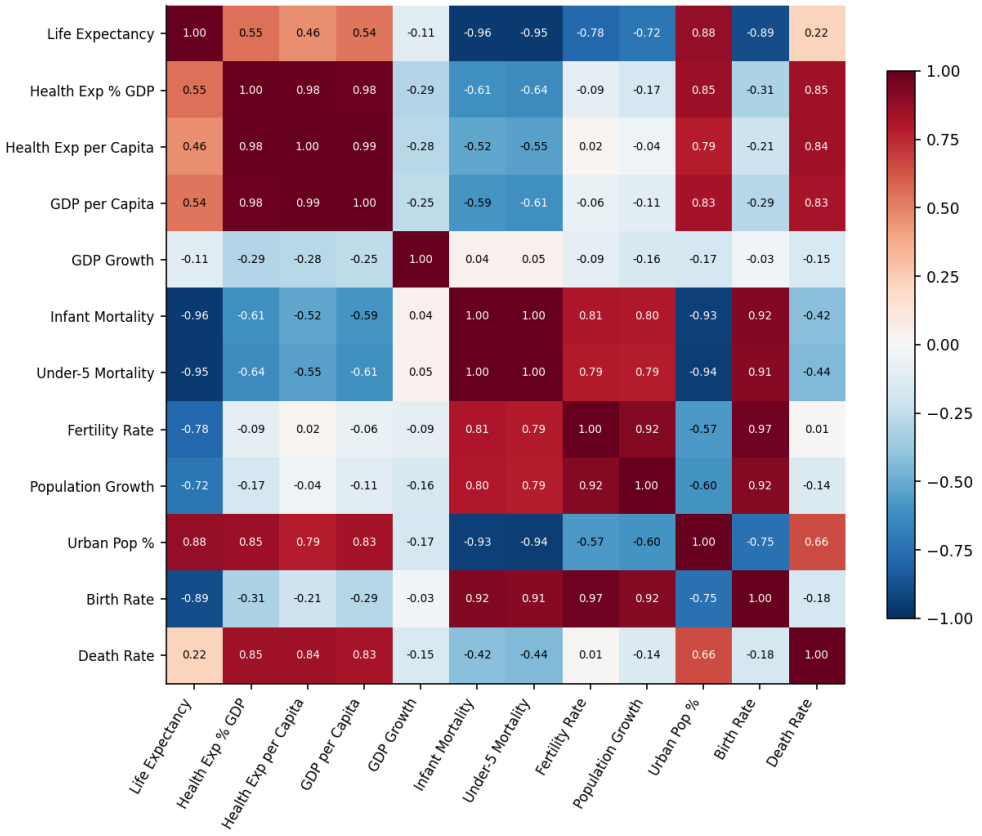


Table 6: *Correlation of each variable with life expectancy*

Variable	Pearson r	Spearman ρ	p-value	Strength
Infant Mortality	-0.957	-0.784	< 0.001	Very strong
Under-5 Mortality	-0.954	-0.673	< 0.001	Very strong
Birth Rate	-0.887	-0.744	< 0.001	Very strong
Urban Population (%)	0.880	0.746	< 0.001	Very strong
Fertility Rate	-0.784	-0.746	< 0.001	Strong
Population Growth (%)	-0.722	-0.607	0.002	Strong
Health Exp % GDP	0.550	0.579	0.034	Moderate
GDP per Capita (US$)	0.536	0.700	0.039	Moderate
Health Exp per Capita (US$)	0.464	0.657	0.081	Moderate
Death Rate	0.224	0.143	0.422	Weak
GDP Growth (%)	-0.105	-0.229	0.710	Negligible

Figure 6: *Strength and direction of correlation with life expectancy*

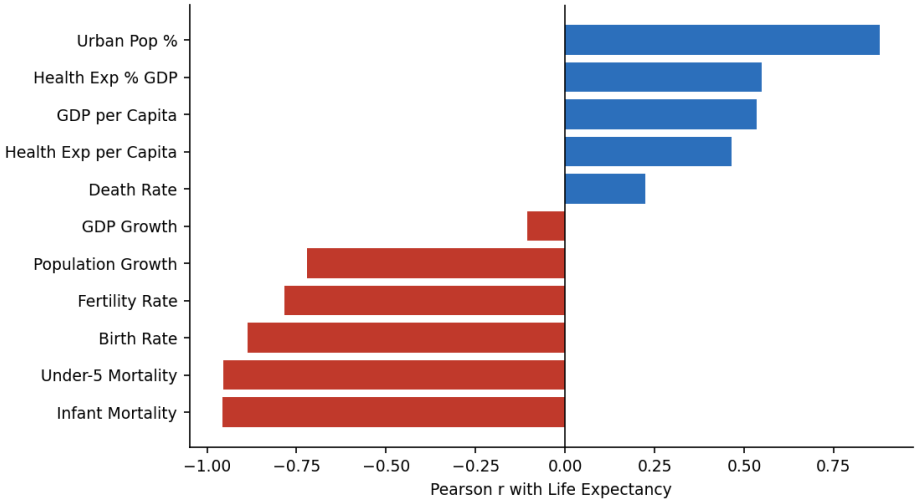
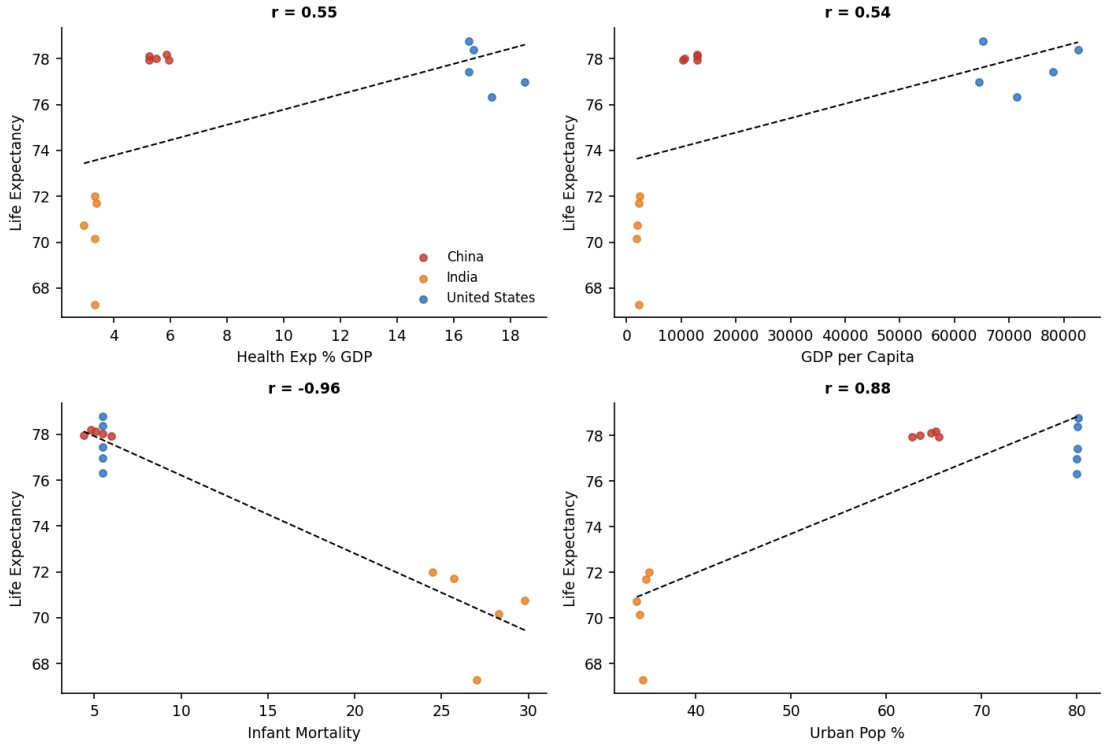


Figure 7: *Scatter plots of life expectancy against four key variables*



Interpretation: Mortality and demography have the strongest links. Infant mortality (r = −0.957) and under-5 mortality (−0.954) are almost perfectly negatively related to life expectancy, which is expected since child deaths pull the average age at death down. Birth rate (−0.887), urbanisation (+0.880), fertility (−0.784) and population growth (−0.722) are also strongly related and all reflect the demographic transition.

Health expenditure and income are positively related but less strongly. Health expenditure as % of GDP (r = 0.550, p = 0.034) and GDP per capita (0.536, p = 0.039) are moderately and significantly correlated with life expectancy. Health expenditure per capita (r = 0.464) is positive but not significant at the 5% level (p = 0.081). The Spearman rank values are higher (0.579, 0.700 and 0.657), which means the relationship

is consistently increasing but curved: extra spending adds a lot of life at low levels and little at high levels, the diminishing-returns pattern of the Preston curve. This is why a logarithmic form is used in the regression.

Pooled correlations mostly reflect differences between countries. The United States spends far more than India or China yet has a similar level of life expectancy, and the five-year window includes the pandemic dip, so the correlations should be read as cross-country associations. GDP growth (−0.105, p = 0.710) and the death rate (+0.224, p = 0.422) are not significantly related to life expectancy; the crude death rate depends on a population's age structure..

Hypothesis testing based on correlation

Hypothesis	r	p-value	Decision at 5%	Conclusion
H1: Health exp. per capita and life expectancy	+0.464	0.081	Fail to reject H_0	Positive but not significant at 5% (significant at 10%)
H2: Health exp. (% GDP) and life expectancy	+0.550	0.034	Reject H_0	Significant positive correlation
H3: GDP per capita and life expectancy	+0.536	0.039	Reject H_0	Significant positive correlation
H4: Infant mortality and life expectancy	−0.957	< 0.001	Reject H_0	Significant negative correlation

4.3 Regression analysis

Life expectancy is the dependent variable. Because the scatter plots show a curved relationship with spending, health expenditure per capita is used in natural-log form. Three models were estimated by ordinary least squares (n = 15).

SUMMARY OUTPUT

CHINA REGRESSION

Regression Statistics	
Multiple R	0.70
R Square	0.49
Adjusted R Square	-0.02
Standard Error	0.11
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.02	0.01	1.0	0.5
Residual	2	0.03	0.01		
Total	4	0.05			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	75.787	2.123	35.692	0.001	66.651	84.923	66.651	84.923
GDP_per_Capita	0.000	0.000	1.234	0.342	0.000	0.001	0.000	0.001
Infant_Mortality_Rate	0.169	0.205	0.825	0.496	-0.712	1.049	-0.712	1.049

The regression model for China shows an R^2 value of 0.49, meaning GDP per capita and infant mortality rate together explain about 49% of the variation in life expectancy. However, the model is not statistically significant (Significance F = 0.50), and neither variable has a significant individual relationship with life expectancy (p-values above 0.05).

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.3
R Square	0.1
Adjusted R Square	-0.8
Standard Error	2.5
Observations	5

INDIA REGRESSION

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1.6	0.8	0.1	0.9
Residual	2	12.6	6.3		
Total	4	14.2			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	85.27	58.02	1.47	0.28	-164.38	334.91	-164.38	334.9
GDP_per_Capita	0.00	0.01	-0.13	0.91	-0.05	0.05	-0.05	0.1
Infant_Mortality_Rate	-0.42	1.22	-0.35	0.76	-5.69	4.84	-5.69	4.8

The regression analysis for India shows that GDP per capita and infant mortality rate together explain around 11% of the variation in life expectancy ($R^2 = 0.11$). However, the overall model is not statistically significant (Significance F = 0.9), and both variables have p-values above 0.05, so their individual relationships with life expectancy are not statistically significant in this analysis.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.86
R Square	0.74
Adjusted R Square	0.47
Standard Error	0.73
Observations	5

USA REGRESSION

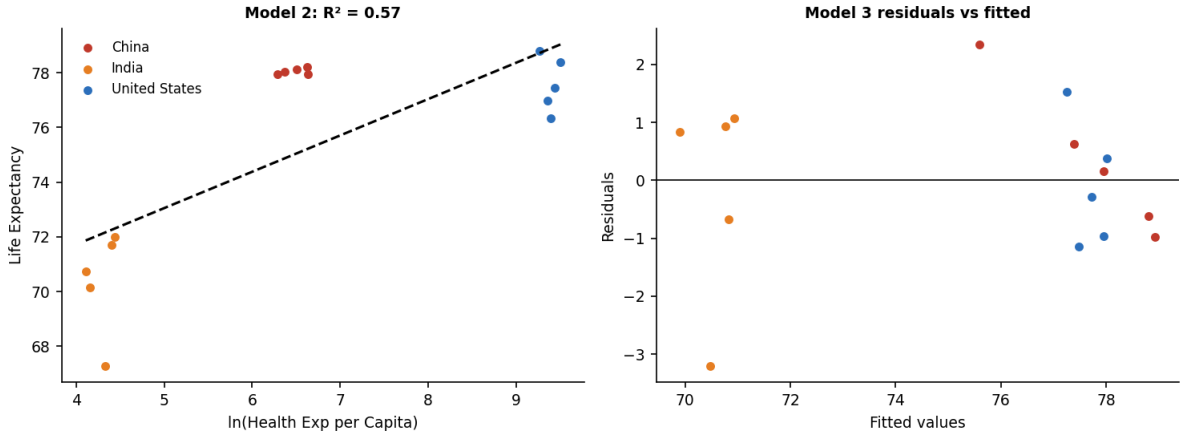
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	2.99	1.49	2.80	0.26
Residual	2	1.07	0.53		
Total	4	4.05			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	76.23177795	3.351775763	22.74369866	0.001927617	61.81025081	90.65330509	61.81025081	90.65331
GDP_per_Capita	1.8683E-05	4.61096E-05	0.405185543	0.724572233	-0.000179711	0.000217077	-0.000179711	0.000217
Infant_Mortality_Rate	0	0	#NUM!	#NUM!	0	0	0	0

The regression analysis for the USA shows an R^2 value of 0.74, meaning GDP per capita and infant mortality rate together explain 74% of the variation in life expectancy. However, the overall model is not statistically significant (Significance F = 0.26), and the infant mortality results show calculation errors, so the model should be checked before drawing final conclusions.

Figure 8: *Model 2 fitted line and Model 3 residuals*



Hypothesis testing based on regression

Hypothesis	Test statistic	p-value	Decision at 5%	Conclusion
H5: β of ln(health exp. per capita) = 0 (Model 3)	t = 4.47; F = 25.6	< 0.001	Reject H_0	Health spending has a significant effect on life expectancy, after controlling for fertility and GDP growth

4.4 Forecast

Life expectancy for 2024–2028 is forecast for each country with two simple methods: (i) a linear trend fitted by least squares to the 2019–2023 series, and (ii) a no-change benchmark that holds the 2023 level constant. Because the five-year window contains the COVID-19 dip, the linear trend is unstable and the two methods are presented as a plausible range.

FORECASTING			
LIFE EXPECTENCY AT BIRTH			
Year	China	India	USA
2019	77.94	70.75	78.79
2020	78.02	70.16	76.98
2021	78.12	67.28	76.33
2022	78.20	71.70	77.43
2023	77.95	72.00	78.39
2024	78.11	71.59	77.48
2025	78.13	72.00	77.44
2026	78.15	72.41	77.41

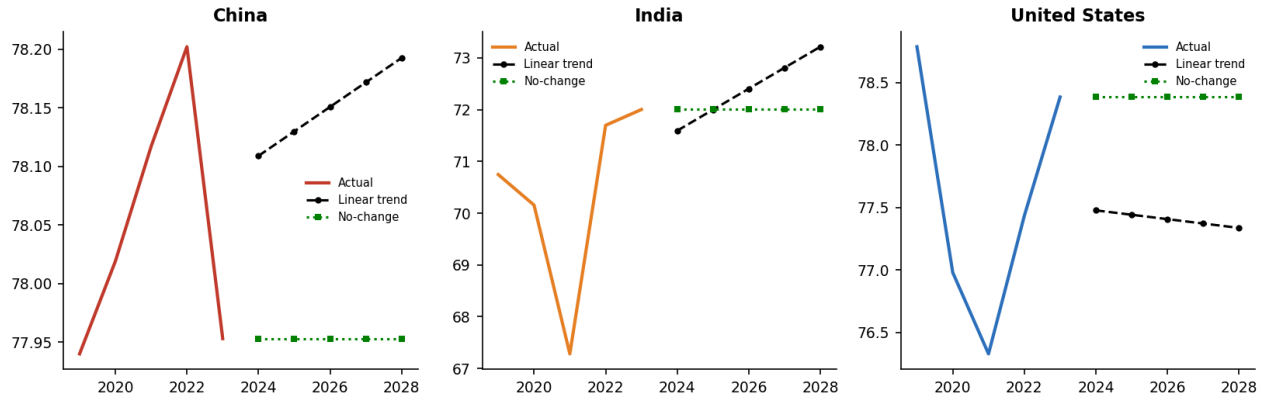
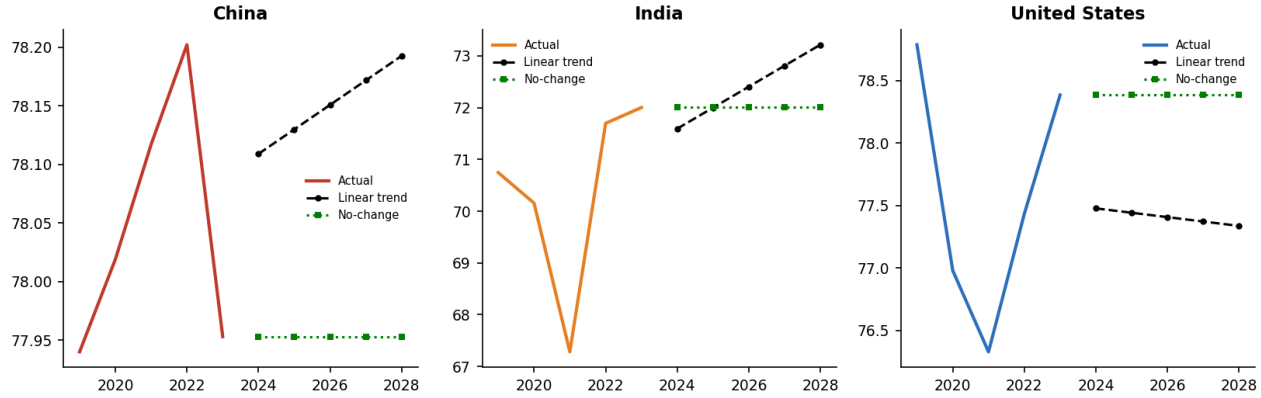


Figure 10: *Actual and forecast life expectancy*



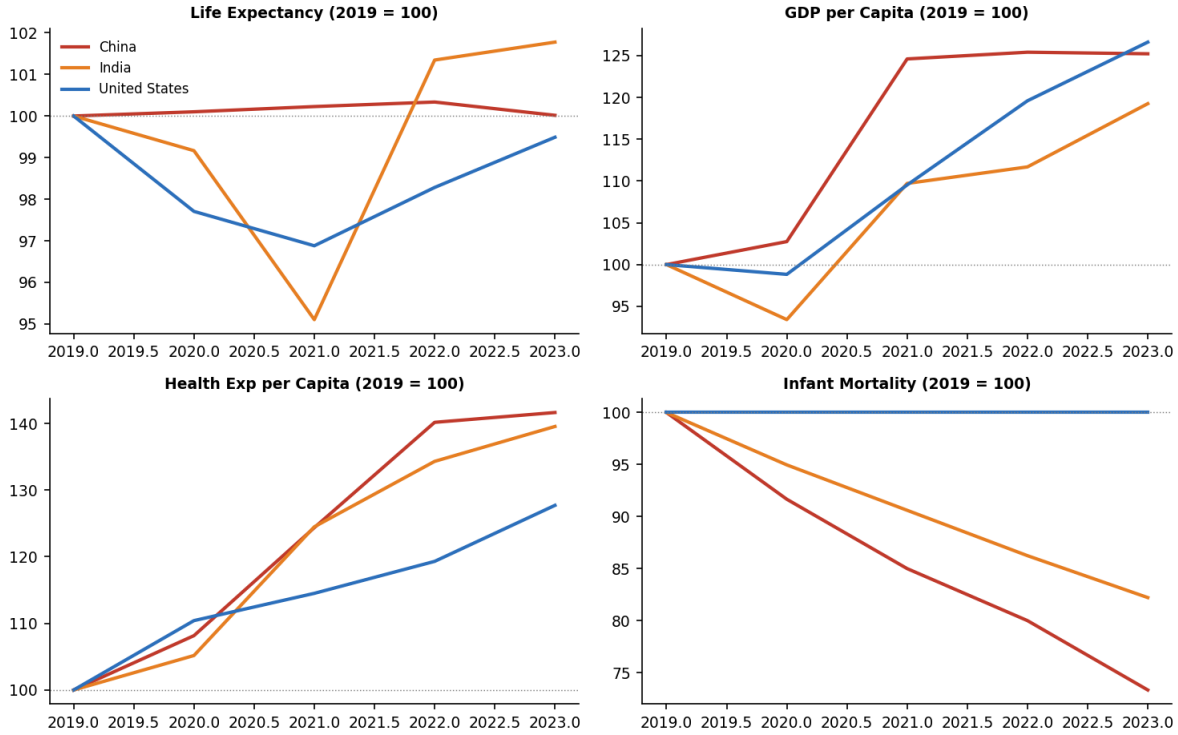
4.5 Index numbers

To compare countries that differ enormously in scale, four variables are expressed as **fixed-base index numbers with 2019 = 100**: Index = (Value in year t ÷ Value in 2019) × 100. The average annual change is (Index$_{2023}$ ÷ 100)^(1/4) − 1.

Table 11: *Index numbers (2019 = 100), 2019–2023*

INDEXING		
CHINA		
A (Year)	B (China Forecast)	C (Index Number)
2019.0	77.9	100.0
2024.0	78.1	100.2
2025.0	78.1	100.2
2026.0	78.2	100.3
INDIA		
A (Year)	B (INDIA Forecast)	C (Index Number)
2019.0	70.7	100.0
2024.0	71.6	101.2
2025.0	72.0	101.8
2026.0	72.4	102.3
USA		
Year	USA Forecast	Index Number
2019.0	78.8	100.0
2024.0	77.5	98.3
2025.0	77.4	98.3
2026.0	77.4	98.2

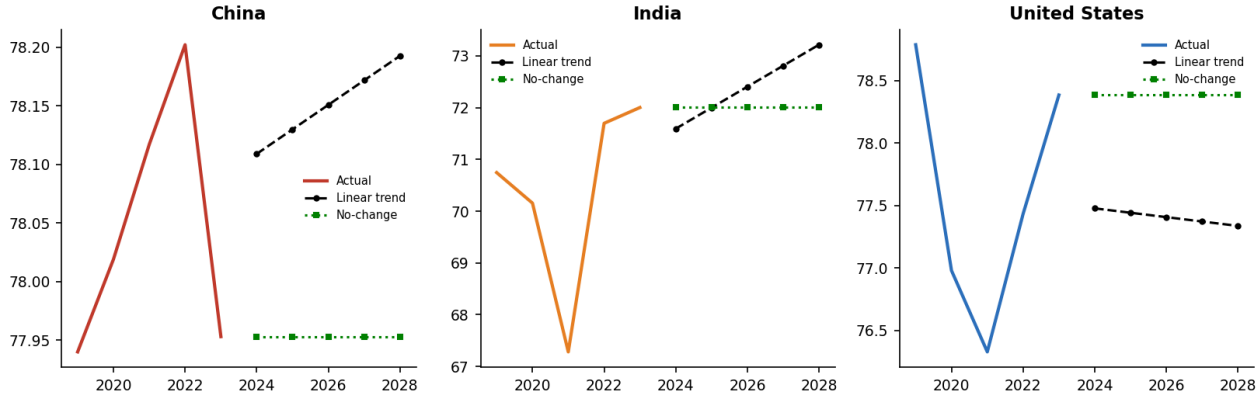
Figure 9: *Index numbers (2019 = 100) of four variables, 2019–2023*



Interpretation: Life expectancy: India fell to an index of 95.1 in 2021 and recovered to 101.8 by 2023 (+1.8% on 2019). The United States fell to 96.9 in 2021 and stood at 99.5 in 2023, still below its 2019 level, while China stayed at 100. Health spending per person rose in all three countries: to 141.6 in China, 139.5 in India and 127.7 in the USA. GDP per capita rose to 126.6 in the USA, 125.2 in China and 119.3 in India. Infant mortality fell to 73.3 in China and 82.2 in India but stayed at 100 in the USA.

> Spending rose by a similar proportion in all three countries, so the different life-expectancy outcomes were shaped more by the pandemic and by existing health conditions than by the growth in spending.

Figure 10: *Actual and forecast life expectancy*



5. Findings and Conclusion

Dashboard



Source:https://docs.google.com/spreadsheets/d/11A7Zx_Wa-2LodK_m8PUBRfCErSM9EcWj/edit?usp=drive_link&ouid=107153764367387308332&rtpof=true&sd=true

- **Uneven recovery:** between 2019 and 2023 life expectancy was flat in China (77.94 to 77.95), rose 1.25 years in India (70.75 to 72.00) after a fall to 67.28 in 2021, and was still 0.40 years lower in the USA (78.79 to 78.39).
- **Spending is positively related to longevity** (H2, H3, H4 and H5 rejected H_0; H1 was positive but not significant at 5%, p = 0.081), with **diminishing returns**: doubling per-capita health spending is associated with roughly 0.65 to 0.92 additional years. The US spends about 159 times India's per-capita amount for only about 6.4 more years of life.
- **Child mortality and demography matter most:** infant mortality ($r = -0.957$) and fertility are the strongest correlates, which suggests that spending is effective mainly when it reduces early-life deaths.
- **The model is strong but not causal:** Model 3 explains 87.5% of the variation, but with 15 observations and mostly between-country variation the results should be read as associations.
- **COVID-19** left a clear mark: India's life expectancy dropped to 67.28 in 2021 (from 70.75 in 2019) and the USA's to 76.33, before both recovered partly or fully by 2023. Health spending per person rose in all three countries over the period (by 28% to 42%).

- **Outlook:** indicative 2028 ranges are about 78 years for China, 72–73 for India and 77–78 for the USA, but these are low-reliability forecasts.

Recommendations

- India should raise public health spending as a share of GDP (currently 3.3%), focusing on child and maternal health, and on resilience to health shocks such as the 2021 wave.
- For high-spending countries such as the USA, policy should focus on how efficiently money is spent (access, prevention and equity) instead of spending more.
- Future research should extend the sample to more countries and years, add education and nutrition variables, and use panel methods that handle autocorrelation (for example fixed-effects models).

6. Mangerial Implication

This research has provided many insights for managers and policymakers regarding how much money is being spent on health care and what effect it has on people's lives. It was demonstrated that simply spending more money on health care does not necessarily lead to better health outcomes when comparing India, China, and the United States. In addition to spending money on health care, proper planning, efficient use of resources, and quality health care services are equally important.

1. Focus on the efficient use of health care budgets

India spends significantly less on health care per person than both China and the United States. Therefore, managers and policymakers should focus on increasing investments in health care while ensuring that the available budget is used efficiently. Some ways to achieve this include improving government hospitals, providing affordable medications, and strengthening primary health care.

2. Prioritize reducing infant mortality

The study indicated a very strong negative correlation between infant mortality and life expectancy. That is, countries with higher infant mortality generally had lower life expectancy in the data. Managers should focus on providing better maternal care, regular health check-ups, child nutrition, and access to emergency medical services to improve health outcomes.

3. Learn from the health care systems of other countries

During the study period, China maintained a relatively stable life expectancy of approximately 78 years; however, India experienced a significant recovery after the decline in 2021. Although the United

States spent the most on health care, it did not fully recover its 2019 life expectancy level by 2023. These findings indicate that India should learn from the experiences of other countries and focus on improving the quality, accessibility, and efficiency of health care services rather than solely comparing spending levels.

4. Base managerial decisions on data

The study demonstrated that health care expenditures as a percentage of GDP and GDP per capita have a significant positive relationship with life expectancy. Managers can utilize such data to identify key areas for investment, establish priorities, and assess the performance of health care programs. Additionally, regular monitoring can assist managers in determining if the funds invested are producing the desired results.

5. Plan for unanticipated health crises

The COVID-19 pandemic impacted life expectancy in both India and the United States. This demonstrates the necessity of developing effective emergency plans. Health care managers should ensure they have adequate supplies of essential medical equipment, develop emergency response plans, train health care personnel, and enhance public health infrastructure to better respond to future health crises.

Overall Implication

As of MBA student, We recognize from this study that successful management involves not only allocating additional resources but also utilizing them appropriately. Countries can enhance public health by making informed decisions, establishing clear priorities, and continually assessing results. For India, the primary objective should be to provide affordable health care, decrease infant mortality, and ensure that health care resources are directed toward those who require them most.

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