

# Analyzing the Relationship Between Current Health Expenditure and GDP Growth in south America

Md Abdullah Al Mahmud Khosru – 23070520

This study investigates the connection between Current Health Expenditure as a Percentage of GDP and GDP Growth in South American countries, addressing the critical question of how health investments influence economic performance. Using data sourced from the World Bank, the research examines trends in health expenditure and economic growth for 12 South American nations over the period 2014 to 2023. A streamlined data pipeline ensures efficient extraction, cleaning, and integration of these datasets. The analysis aims to uncover meaningful patterns that provide insights into the role of health investment in shaping regional economic growth.

## I. DATA SOURCES

For this project, we investigated the influence of current health expenditure as a percentage of GDP on economic growth in South American countries between 2014 and 2023. The dataset was generated using an automated ETL pipeline designed to extract, clean, and process GDP growth and health expenditure data from the World Bank API. The GDP dataset captures annual growth rates, while the health expenditure dataset reflects the proportion of GDP allocated to healthcare spending. Together, these datasets provide a comprehensive view of the relationship between economic growth and health investment across South America.

The ETL pipeline ensured high data quality and consistency. The pipeline automatically downloaded and extracted the raw data in CSV format and filtered it for 12 South American countries, including Argentina, Brazil, Chile, and Venezuela, focusing on the years 2014 to 2023. It reshaped the data from a wide to a long format, facilitating temporal and cross-country comparisons. To address missing values, rows with significant gaps were removed, while minor missing values were replaced with 0 to ensure continuity and maintain analytical integrity. Features like "Country Name," "Year," and "Value" were structured to enable robust analysis.

The pipeline exported cleaned datasets into an SQLite database with separate tables for GDP growth and health expenditure, enabling efficient querying and advanced analyses like regression and trend analysis. Scaling and normalization ensured comparability across countries and years, providing a robust dataset to explore the relationship between healthcare investments and economic growth in South America.

### A. Data Structure

The datasets utilized in this study were sourced from the World Bank Open Data platform, ensuring reliable, accurate, and globally recognized information for cross-country comparisons. These datasets encompass comprehensive details on health expenditure and GDP growth for 12 South American countries over the period 2014–2023.

**1. Health Expenditure Data:** The health expenditure dataset represents the current health expenditure as a percentage of GDP, providing insights into how much each country allocates to healthcare relative to its economic size.

Health Expenditure Data Table (Top 6 rows):				
	Country Name	Country Code	Year	Value
0	Argentina	ARG	2014	9.6713
1	Bolivia	BOL	2014	5.89614
2	Brazil	BRA	2014	8.39644
3	Chile	CHL	2014	7.8415
4	Colombia	COL	2014	7.18553
5	Ecuador	ECU	2014	6.832

Fig. 1. Samples from Health Expenditure Table.

This data enables the analysis of trends and comparisons in healthcare spending across the region. Samples from the dataset (pipeline output) are shown below.

**2. GDP Growth Data :** The GDP growth dataset captures the annual percentage change in

GDP for each country. This data is critical for understanding economic fluctuations and growth trends across South America, offering insights into the region's economic performance. Samples from the dataset (pipeline output) are shown below

GDP Data Table (Top 6 rows):

	Country Name	Country Code	Year	Value
0	Argentina	ARG	2014	-2.51262
1	Bolivia	BOL	2014	5.46057
2	Brazil	BRA	2014	0.503956
3	Chile	CHL	2014	1.79265
4	Colombia	COL	2014	4.49903
5	Ecuador	ECU	2014	4.22607

Fig. 2. Samples from GDP Growth table.

### B. License

The datasets used in this study, sourced from the World Bank Open Data platform, are made available under the Creative Commons Attribution 4.0 International (CC BY 4.0) license. This license permits the datasets to be shared, adapted, and utilized for any purpose, provided that appropriate credit is given to the original source. To comply with this license, proper attribution will be included in all reports, presentations, and publications resulting from this research. Additionally, any modifications or derived versions of the datasets will retain the CC BY 4.0 license to uphold transparency and encourage further research in this domain.

## II. ANALYSIS

To understand how current health expenditure as a percentage of GDP influences economic growth in South American countries, we performed several data visualization techniques for example Time Series Analysis, Correlation Analysis and Country-wise trends, were examined to uncover variations in healthcare investments and their corresponding impact on economic growth across different nations and years. These analyses provide valuable insights into the interplay between public health spending and GDP growth at both regional and temporal levels.

### 1. Method:

To address the research question, "How does current health expenditure as a percentage of GDP influence economic growth in South American countries between 2014 and 2023?", a systematic methodology was adopted to ensure accurate and insightful analysis. The methodology involved the following steps:

A) Data Collection: The datasets for GDP growth rates and current health expenditure were collected from the World Bank API. The data collection process included downloading ZIP files, extracting CSV files, and loading them into a structured environment for analysis.

B) Data Cleaning: Irrelevant columns, such as metadata and indices, were removed. Missing values in health expenditure data were replaced with NaN to avoid bias, while other missing values were filled using backward-fill (bfill) imputation. Data was filtered to include only 12 South American countries and the years 2014 to 2023, ensuring alignment with the research question.

C) Data Transformation and Integration: The datasets were transformed and merged for consistency and compatibility with analysis requirements:

i) Reshaping: Data was transformed into a long format using pandas' melt() function, organizing it by country, year, and value.

ii) Integration: The GDP growth and health expenditure datasets were merged on "Country Name" and "Year" to create a unified dataset for analysis.

D) Data Storage: The cleaned and transformed datasets were stored in both SQLite databases and CSV files, ensuring accessibility and reusability for further analysis and visualization. This comprehensive and systematic methodology ensured that the data was accurate, well-structured, and suitable for analyzing the interplay between healthcare investments and economic growth in South America.

**i. Time Series Analysis) :** As part of the EDA, we performed Time Series Analysis to look closely at trends in GDP growth and health spending for each country over time. Through data visualization, we were able to identify important trends including economic volatility during world events,

GDP growth recoveries following downturns, and steady regional variations in health spending as a percentage of GDP. This analysis provided a comprehensive view of long-term trends and notable year-to-year variations in both indicators, highlighting country-specific trajectories.

**ii. Correlation Analysis:** A correlation matrix heatmap was employed to quantify relationships between GDP growth and health expenditure. This analysis revealed whether higher health spending correlated with improved economic performance, offering insights into the underlying dynamics of economic development.

**iii. Country-wise Trends:** Country-specific analyses focused on identifying yearly variations in GDP growth and health expenditure for each South American country. Line plots were generated to track these changes, enabling a detailed comparison of national trends and the identification of unique patterns.

**2. Result:** let's explore the findings to uncover the key insights derived from the analysis

**i. Time Series Analysis:** The line chart depicts GDP growth trends in South American countries. **Guyana** experienced a sharp increase in GDP growth, reaching over 60% in 2020–2022, largely attributed to its expanding oil sector. Other countries, such as **Argentina and Venezuela**, faced consistent economic contractions during the period, with negative growth rates in several years. The COVID-19 pandemic in 2020 caused a significant dip in GDP for most nations, followed by recovery trends in 2021 and 2022. This visualization highlights the diverse economic trajectories within the region. Countries like **Bolivia and Uruguay** maintained more stable GDP growth, averaging around 2–5% annually. These variations emphasize the economic diversity within the region.

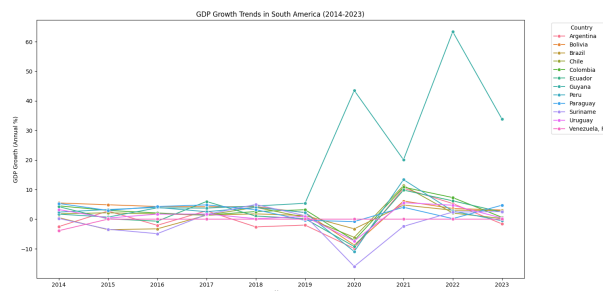


Fig. 3. GDP Growth Trends.

The line graph shows trends in health spending in South American nations as a percentage of GDP. Over the years, **Argentina** has continuously had the highest health spending, accounting for over 9% of GDP. With spending levels above 8%, **Uruguay and Chile** came next, exhibiting steady rises. **Guyana and Venezuela**, on the other hand, had noticeably lower percentages, with Venezuela seeing a precipitous drop after 2018. The majority of nations showed consistent increases in health spending over time, indicating a growing emphasis on regional healthcare investment.

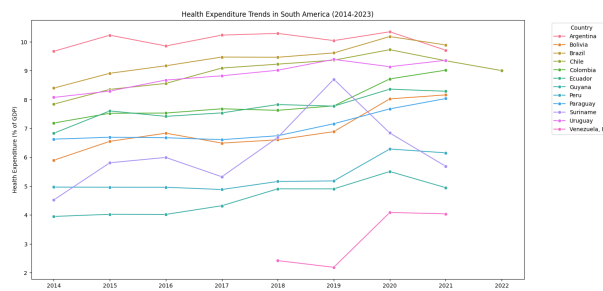


Fig. 4. Health Expenditure Trends.

**ii. Correlation Analysis:** The correlation matrix heatmap illustrates the relationships between Year, GDP growth (Value gdp), and health expenditure (Value health). A moderate positive correlation (0.38) exists between Year and GDP growth, indicating a general upward trend over time. A weak negative correlation (-0.16) is observed between GDP growth and health expenditure, suggesting a slight inverse relationship. Year and health expenditure show a weak positive correlation (0.30), indicating a gradual increase in health expenditure over time. This visualization highlights nuanced dynamics among these variables.

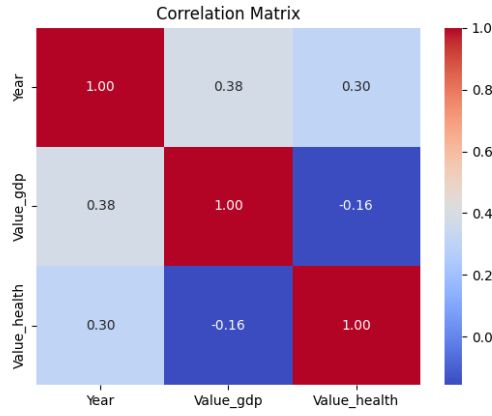


Fig. 5. correlation matrix heatmap.

**iii. Country-wise Trends:** The country-wise trends chart showcases GDP growth (blue) and health expenditure (orange) as a percentage of GDP from 2014 to 2023 for various South American nations.

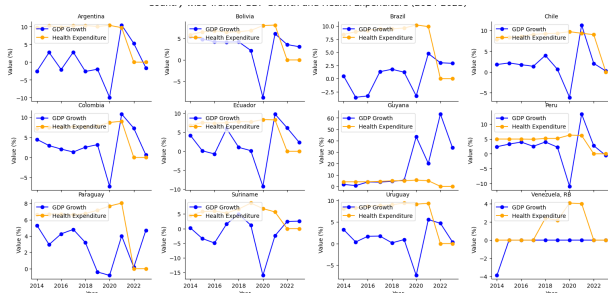


Fig. 6. Country-wise Trends.

Notable patterns include Guyana's sharp spikes in GDP growth during 2020-2021, contrasting with relatively stable health expenditures. Argentina, Brazil, and Chile exhibit fluctuations in GDP growth with health expenditures remaining more consistent over the years. Venezuela demonstrates persistent declines in GDP growth coupled with relatively flat health expenditure trends. These comparative insights highlight how economic and health expenditure trends vary significantly across countries.

### 3. Interpretation:

**i. Time Series Analysis:** Trends indicate that higher health expenditure does not always correspond to immediate economic growth. For example, Guyana's GDP growth surged due to its

booming oil sector despite relatively low health expenditure, while Argentina and Venezuela faced economic decline despite consistent or increased health spending. This suggests that factors beyond health expenditure, such as resource utilization and political stability, play a critical role in economic growth.

**ii. Correlation Analysis:** The weak negative correlation (-0.16) between health expenditure and GDP growth highlights that increased health spending does not directly drive short-term economic performance. However, the gradual rise in health expenditure across countries reflects long-term investments in public health, which could influence future economic stability.

**iii. Country-wise Trends:** Countries like Argentina, Brazil, and Chile maintained steady health expenditure alongside moderate GDP fluctuations, suggesting that balanced health spending supports economic resilience. In contrast, Venezuela's declining GDP growth aligns with its reduced healthcare investment, highlighting the detrimental effects of economic crises on both health and economic systems.

## III. CONCLUSION

The analysis indicates that current health expenditure as a percentage of GDP has a nuanced influence on economic growth in South America between 2014 and 2023. While a direct and strong correlation is not evident, countries with higher health spending, such as Brazil and Chile, demonstrated greater economic resilience during downturns, suggesting that robust healthcare investment supports long-term economic stability. This implies that while health expenditure may not directly drive immediate GDP growth, it underpins sustainable economic development by fostering stability and resilience in the face of economic challenges.

## REFERENCES

- [1] World Bank Open Dataset Online:  
<https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>
- [2] Creative Commons Attribution 4.0 International (CC BY 4.0):  
<https://datacatalog.worldbank.org/public-licensescc-by>
- [3] World Bank Open Dataset Online:  
<https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS>