GDP, Health Expenditure, and Mortality: A Global Analysis

Sanjay Kasi, Mahlet Ayele

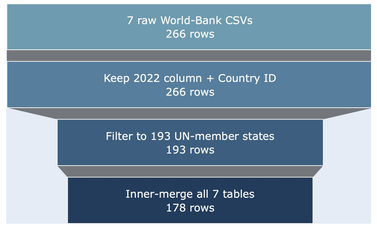
Datasci 112

Abstract

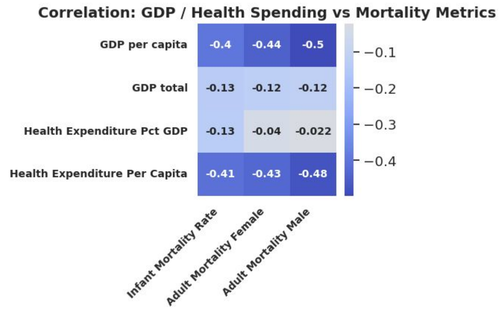
This study examines how national Health Expenditure per capita and GDP per capita relate to adult and infant mortality rates across 178 countries using 2022 World Bank data. We analyzed seven key economic and health indicators to determine which factors most strongly predict mortality. A random forest regression identified GDP per capita and Health Expenditure per capita as the top predictors. We then ran a scaled linear regression analysis (with cross-validation) to compare feature weights for each mortality outcome, confirming that, for adult mortality, GDP per capita carries more weight, whereas for infant mortality, Health Expenditure per capita carries more weight. Finally, unscaled linear regression quantified the effect of increasing Health Expenditure per capita on mortality while holding GDP per capita constant. Our results show that, at the mean GDP per capita, every additional $1,000 in Health Expenditure per capita is associated with approximately three fewer infant deaths per 1,000 live births. These findings suggest that targeted increases in health expenditure can lead to measurable improvements in infant survival.

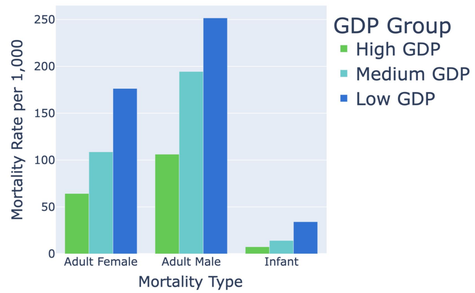
Data Collection

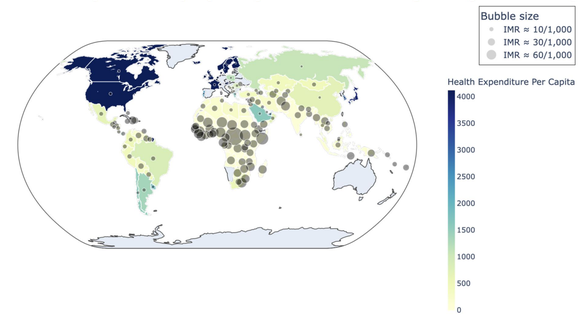
- **Sources:** 7 World Bank CSV files – 1) GDP per capita, 2) total GDP, 3) Health Expenditure as a % of GDP, 4) Health Expenditure per capita, 5) Infant Mortality Rate, 6) Adult Female Mortality Rate, 7) Adult Male Mortality Rate.
- **Load:** pd.read_csv(..., skiprows=4) to drop World Bank metadata rows.
- **Year filter:** Only 2022 data was chosen, as it is the first full post-lockdown year and the latest common year across all sources.
- **Country filter:** Inner-join the GDP per capita table with the 193-state UN list on Country Code (removes non-country data such as "World", "Sub-Saharan Africa", etc.).
- **Merge:** Inner-merge all seven tables on Country Code, resulting in merged_df with data for 178 sovereign nations. The final merged_df contains country code, country name, GDP per capita, total GDP, Health Expenditure per capita, Health Expenditure as a percentage of GDP, infant mortality rate, adult female mortality rate, and adult male mortality rate.



Do GDP and Health Expenditure impact mortality?





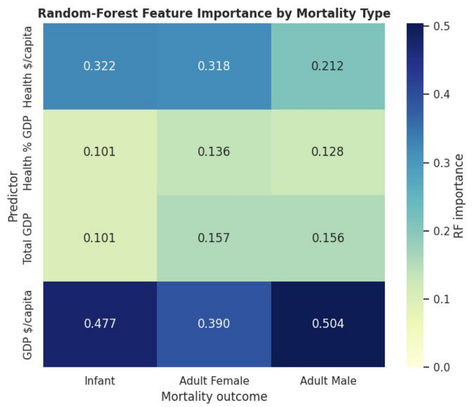


What we learned

- All four predictors (GDP per capita, total GDP, Health Expenditure per capita, and Health Expenditure as a % of GDP) show negative correlations with infant, adult male, and adult female mortality rates.
- Wealthier countries—measured by total GDP and per capita GDP—tend to have lower mortality rates across all groups.
- Countries that spend more on healthcare, both per capita and as a percentage of GDP, also exhibit lower mortality rates across all groups.

Which features matter?

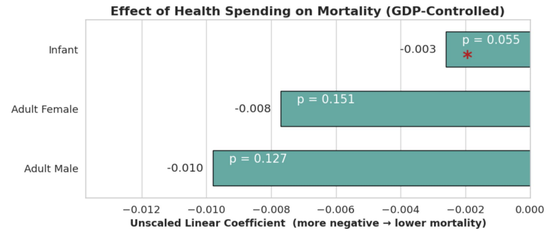
1. **Random Forest Regression (with GridSearchCV)**
   a. Provided a nonlinear, ensemble-based method to assess feature importance.
   b. Ranked predictors by feature importance.
   c. The top drivers were **GDP per capita** and **Health Expenditure per capita**.
2. **Scaled Linear Regression (with GridSearchCV)**
   a. Included our two top predictors in our linear regression model and scaled the data.
   b. We examined the coefficients of the best model (as found through GridSearchCV) to better understand direction and strength of relationships.
3. **Unscaled Linear Regression**
   a. Showed the direct numeric effect of Health Expenditure per capita while holding GDP per capita constant.
   b. Significance flagged at **$p < 0.05$ (significant)** and **$p < 0.10$ (marginally significant)** for each mortality metric.



Mortality Metric	GDP per capita	Health Expenditure per capita
Adult Male	**-36.046**	-20.754
Adult Female	**-24.690**	-16.350
Infant	-3.900	**-5.496**

Research Question

What is the effect of increasing health expenditure per capita on mortality rates after controlling for GDP per capita?



* p < .10 ** p < .05 *** p < .01

Key Takeaways

Our analysis of 2022 World Bank data demonstrates that GDP per capita and Health Expenditure per capita are the strongest predictors of mortality across countries. While all three mortality rates decrease as Health Expenditure per capita rises, **only the relationship with infant mortality reaches marginal significance ($p = 0.055$).** This finding is supported by our scaled linear-regression coefficients: GDP per capita has a larger weight on adult mortality, whereas **for infants, Health Expenditure per capita outweighs GDP per capita.** In practical terms, at the sample mean GDP per capita, **an additional $1,000 in health expenditure per person is associated with roughly three fewer infant deaths per 1,000 live births.**

These results suggest that increasing Health Expenditure per capita can reduce infant mortality. Although higher health expenditure may also lower adult mortality, those relationships did not achieve marginal statistical significance under our criteria. **Overall, policymakers should recognize that targeted increases in Health Expenditure per capita are likely to yield improvements in infant survival.**

Stanford University