

# Impact of Healthcare Expenditure & HDI on Lifespan Inequality

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# INTRODUCTION

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## **Objectives:**

- Investigate the relationship of how healthcare expenditure per capita & human development index by country impacts inequality in life expectancy.
- Population of interest is all the countries of the world with available data.
- Stakeholders are countries that experience high inequality in life expectancy & have a moral & economic interest in improving standard of living for their respective populations for long-term development. Additional stakeholders include multinational corporations, international organization & NGOs that will play a role in such future development.
- Data is expected to show that increased spending in health expenditure & greater gains in human development will result in a lower lifespan inequality.

## **Research Questions:**

- *Does a country's health expenditure per capita predict its lifespan inequality?*
- *Is there a linear relationship between human development index & lifespan inequality?*

# METHODS

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## Data Collection:

- Sample data was collected from “Our World in Data”, an online scientific publication that focuses on critical global issues regarding poverty, disease, climate change & inequality.
- Sampling units are individual countries of the world.
- Final sample size of this analysis is 177 countries.

## Measures:

- Response variable is lifespan inequality derived from Atkinson index in percentages (%).
- 1<sup>st</sup> explanatory variable is health expenditure per capita measured in purchasing power parity in current international dollars (\$).
- 2<sup>nd</sup> explanatory variable is Human Development Index (HDI) measured by the United Nations, which has no units.

## Analysis Method:

- R Studio, version 3.6.2, was utilized to conduct a General Linear Model test (Multiple Regression with interaction) to analyze the dataset.

# DESCRIPTIVES

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## **Response Variable:**

Table 1 – Descriptive Statistics (n = 177)

	Center	Spread
Lifespan Inequality (%)	12.2	17.9

## **Explanatory Variables:**

	Center	Spread
Health Expenditure (\$)	677.466	1453.767
Human Development	0.726	0.236

# RESULTS

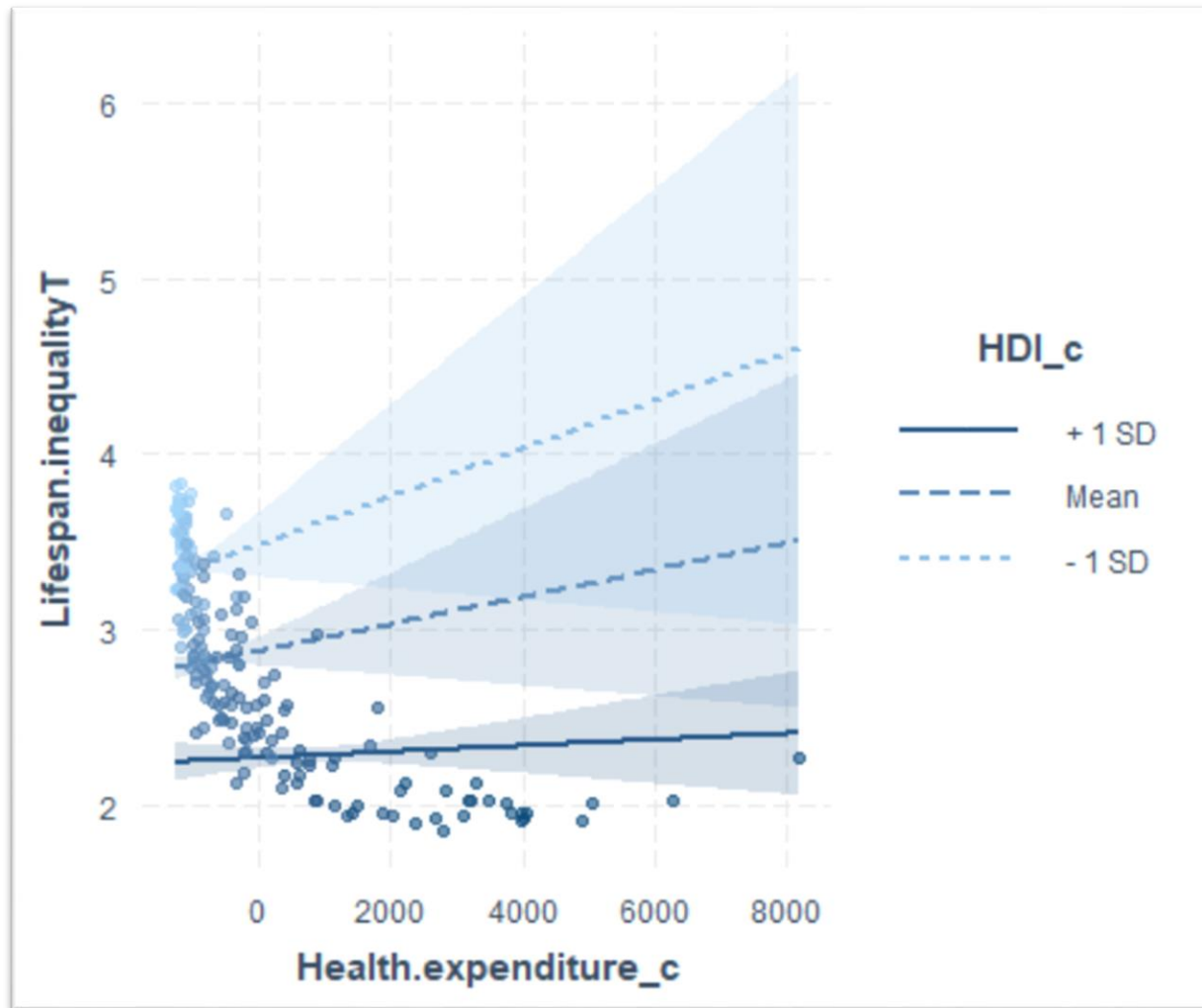
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## Results Table:

Table 2 – General Linear Model Results

Variable	Estimate	Test Statistic	P-value
(Intercept)	2.875	67.203	$2 * 10^{-16}$
Health.expenditure_c	$7.68 * 10^{-5}$	1.416	0.1585
HDI_c	-4.008	-10.708	$2 * 10^{-16}$
Health.expenditure_c:HDI_c	$-3.916 * 10^{-4}$	-1.838	0.0678

Measure of Model Fit (Adjusted  $R^2$ ) = 0.8856



The Interaction Plot (**Graph 1**) exhibits the main effects of both health expenditure per capita & human development index, but no interaction exists between the two explanatory variables in explaining lifespan inequality.

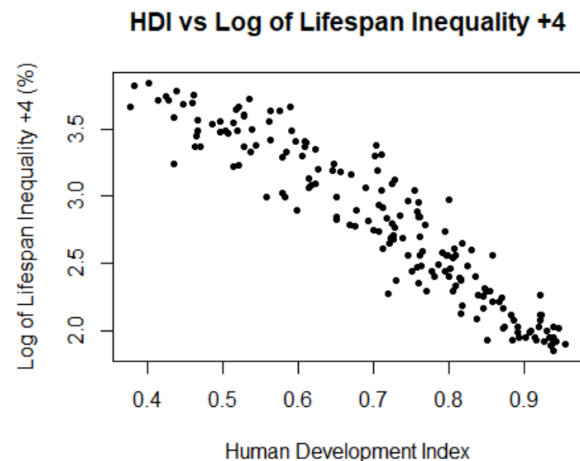
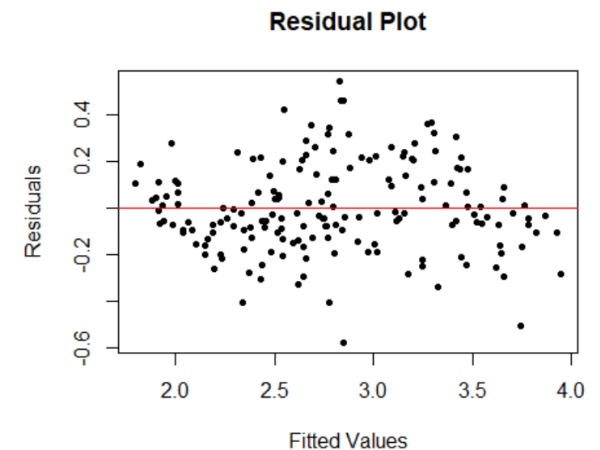
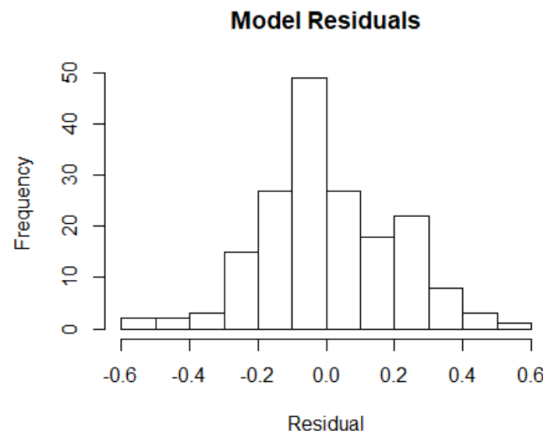
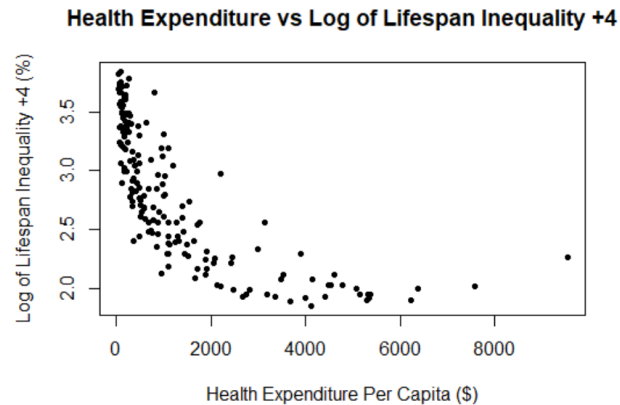
( $t = -1.838$ ,  $df = 173$ ,  $p = 0.0678$ )

Graph 1 – Interaction Plot

# ASSUMPTIONS

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- Random sample of all possible values of  $y$  for each  $x$
- Independent observations
- Each numeric  $x$  is linearly related to  $y$
- Residuals are normally distributed
- Residuals have equal variance across the range of fitted values



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- *Scatter plot of 1<sup>st</sup> explanatory variable fails linearity assumption, but analysis will continue anyway while scatter plot of 2<sup>nd</sup> explanatory variable meets the linearity assumption.*
  - *Model residuals are roughly symmetric in distribution.*
  - *Residual plot confirms equal variance assumption.*
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# DISCUSSION

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## Interpretation:

- Controlling for human development index, health expenditure does NOT explain a significant amount of variation in lifespan inequality ( $t = 1.416$ ,  $df = 173$ ,  $p = 0.159$ ).
- Controlling for health expenditure per capita, human development index explains a significant amount of variation in lifespan inequality ( $t = -10.708$ ,  $df = 173$ ,  $p = 2 * 10^{-16}$ ).
  - Therefore, while holding health expenditure per capita constant, lifespan inequality decreases by 4.008% for every 1 unit increase in human development index.
- The interaction between health expenditure per capita & human development is NOT significant ( $t = -1.838$ ,  $df = 173$ ,  $p = 0.0678$ ).

## Limitations:

- The 1st explanatory variable, health expenditure per capita, failed to meet the assumption of linearity, a required condition in running a GLM or multiple regression analysis with interaction.
- The data itself is outdated by several years as it was collected in 2015. Given that human development can fluctuate quickly over a short time span, conclusions should be taken with a caveat when applying them to the present.
- Human development index, while a standard bearer by the United Nations, is a somewhat controversial measurement as it has been criticized for its lack of consideration of technological development & contributions to the human civilization as criteria, thus being potentially misleading regarding a country's true development.



## **Implications:**

- Human Development Index is a significant indicator in explaining the variation in lifespan inequality among each country, while holding health expenditure constant.
- Results may shine a greater light on parts of the world that are developmentally regressive & rekindle efforts to utilize appropriate resources to close the gap in lifespan inequality.
- Stakeholders may utilize these results to argue for greater intervention in underdeveloped countries via corporate & political forces under the guise of aid to promote their services.

## **Future Research:**

Several opportunities exist in the future to expand existing research & findings into additional areas. For example, Human Development Index is a broad statistical mechanism that composes of life expectancy, education & per capita income indicators via Gross National Income. With the current analysis suggesting that HDI explains a significant amount of variation in lifespan inequality, a potential future project could entail breaking up & investigating each of the HDI mechanisms & their relationship to lifespan inequality. This analysis could reveal how significant each HDI contribution is & whether there is any interaction among them & to what degree.

## **Reference:**

Our World in Data, United Nations Development Programme, World Bank, World Health Organization (2018-2019). *Inequality in life expectancy vs. health expenditure per capita*, 2015. Retrieved from <https://ourworldindata.org/grapher/inequality-in-life-expectancy-vs-health-expenditure-per-capita>