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# 1 Introduction

The 20th century saw amazing advances in health. In 1950, the average life expectancy in developing nations was 40 years, but by 1990, it had risen to 63 years (World Bank, 1993). Improved diet, greater sanitation, medical technology advancements, and public health infrastructure have all contributed to an increase in human life duration.

The proportional importance of these components varies according to the level of economic development; there are synergies between the underlying factors that operate in complicated ways. While acknowledging multiple factors of life expectancy, Preston (1976) highlighted economic growth as the most important element. However, because child mortality has a major influence on life expectancy, low-cost treatments such as antenatal care and immunisation programs in developing countries can be useful tools for increasing life expectancy. In general, economic progress is determined by the population's degree of education and capital formation.The former is impacted by child nutrition, educational infrastructure, and family resources, including the physical health and cognitive attainment of parents (e.g., Fogel, 1994; Scrimshaw, 1996; Bhargava,1998, 1999). Capital accumulation is determined by the savings rate, which is controlled by adult health.[2]

Although human capital definitely contributes considerably to economic growth, most cross-country empirical studies associate labour quality with schooling.Our core thesis is that this approach ignores compelling evidence that health is a vital component of human capital, and hence a critical component of economic growth. Workers who are in better physical and mental health are more active and strong. They are more productive and make more money. They are also less prone to miss work due to sickness (or illness in their family). Illness and disability significantly affect hourly wages, with the effect being more pronounced in developing nations, where a bigger proportion of the working force is engaged in manual labour than in industrial countries.[3]

# 2 Methods

The data we have used is of 261 countries ranging from 1990 to 2020. We have 8247 rows and 10 columns consisting of different indicators which will be used in our analysis and are explained below in detail. As we are using 4 health variables (target variables) we have made 5 models for finding the significance of independent variables (economic growth parameters). After that we will analyze economic parameters Vs Health factors at global scale. Then with the perspective of population we are gonna verify does the same trend is being followed in different countries which differ from each other in terms of population. Therefore, I have divided the countries on basis of population in 3 categories to verify the trends at national scale.

At last we will conclude by discussing, is population really impacting the economic growth and economic growth impacting Health factors. We will look at

the correlation of these factors and whats really the issue.

## 2.1 Data Description

As we will be investigating how economic expansion affects health. As a result, the data we're using comes from data.worldbank.org. We have data on a variety of factors spanning years. I investigated numerous elements that can aid us in better comprehending the reliance. We have reduced down 4 health determinants and 3 economic growth parameters for analytical purposes, and we will study the impacts of economic growth on health on a global and national scale.

### 2.1.1 Health Factors

| Sr. No. | Variable | Description | Data Type |
|---|---|---|---|
| 1. | SP.POP.65UP.TO.ZS | Population ages 65 and above (% of total population) | Numeric |
| 2. | SH.STA.SMSS.ZS | People using safely managed sanitation services (% of population) | Numeric |
| 3. | SH.STA.BASS.ZS | People using at least basic sanitation services (% of population) | Numeric |
| 4. | SH.STA.ODFC.ZS | People practicing open defecation (% of population) | Numeric |
| 5. | SH.DYN.NCOM.ZS | Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%) | Numeric |

Table 1: Health Factors

### 2.1.2 Economic growth parameters

| Sr. No. | Variable | Description | Data Type |
|---|---|---|---|
| 1. | NY.GDP.PCAP.KD | GDP per capita (constant 2015 US$) | Numeric |
| 2. | SH.XPD.CHEX.PC.CD | Current health expenditure per capita (current US$) | Numeric |
| 3. | SH.XPD.CHEX.GD.ZS | Current health expenditure (% of GDP) | Numeric |

Table 2: Economic Factors

## 2.2 More about the Data

We will go through the above factors as its going to be important while understanding the analysis below, even we will discuss how the data was gathered.

- SP.POP.65UP.TO.ZS - Population aged 65 and up as a percentage of total population. The population is based on the de facto definition, which includes all residents regardless of legal status or citizenship.[4]
- SH.STA.BASS.ZS - The proportion of persons who utilise at least basic sanitation services, i.e. improved sanitation facilities not shared with other families. This indicator includes both persons who use basic sanitation services and those who use sanitation services that are appropriately maintained.Flush/pour flush to piped sewer systems, septic tanks, or pit latrines; ventilated improved pit latrines, composting toilets, or pit latrines with slabs are examples of enhanced sanitation facilities.[4]
- SH.STA.ODFC.ZS - Open defecation refers to the proportion of the population that defecates in the open, such as in fields, forests, bushes, open bodies of water, on beaches, in other open places, or in solid waste.[4]
- SH.DYN.NCOM.ZS - Mortality from CVD, cancer, diabetes, or CRD is the percentage of 30-year-olds who would die before their 70th birthday from any of cardiovascular disease, cancer, diabetes, or chronic respiratory disease, assuming current mortality rates at all ages and no other cause of death (e.g., injuries or HIV/AIDS).[4]
- NY.GDP.PCAP.KD - GDP per capita is calculated by dividing gross domestic product by the midyear population. GDP is calculated as the total of the gross value contributed by all resident producers in the economy, plus any product taxes and minus any subsidies not included in the product value. It is computed without regard for depreciation of manufactured assets or depletion and deterioration of natural resources. The data are in 2015 U.S. dollars.
- SH.XPD.CHEX.PC.CD - Current health expenditures per capita in US dollars. Current health spending estimates include healthcare items and services spent each year.[4]
- SH.XPD.CHEX.GD.ZS - Current health spending represented as a percentage of GDP. Current health spending estimates include healthcare items and services spent each year. This measure excludes capital health expenditures such as buildings, machinery, information technology, and vaccine supplies for emergencies or outbreaks[4].

# 3 Results

## 3.1 Statistical Model

When addressing the causes on a global scale, we will primarily focus on the year 2019, and when discussing the same elements on a national size, we will do so over a period of 8 to 30 years, depending on data availability of particular factor. Before working on or applying any analysis to data, some type of preparation is always required. As a consequence, while choosing the components for my study, I picked columns that are relevant and have higher data quality, so that our analysis is correct and we may achieve better findings.

A generalised linear model (GLM) is a versatile expansion of conventional linear regression in statistics. The GLM generalises linear regression by enabling the linear model to be linked to the response variable through a link function and by allowing the size of each measurement's variance to be a function of its predicted value.

In this case, we use the glm model to economic growth characteristics to investigate which ones impact health aspects. Because we are employing 4 health parameters, I utilised 4 linear models to discover which economic growth parameter has the greatest influence on global or national health development.

| Target Variable | Independent Variable | Estimate | Standard Error | P- Value |
|---|---|---|---|---|
| SP.POP.65UP.TO.ZS | NY.GDP.PCAP.KD | 1.392e-04 | 4.609e-05 | 0.00282 |
| | SH.XPD.CHEX.PC.CD | 1.148e-04 | 5.087e-04 | 0.82165 |
| | SH.XPD.CHEX.GD.ZS | 8.782e-01 | 1.687e-01 | 4.49e-07 |
| SH.STA.BASS.ZS | NY.GDP.PCAP.KD | 0.0005412 | 0.0001376 | 0.000113 |
| | SH.XPD.CHEX.PC.CD | -0.0008471 | 0.0018639 | 0.649953 |
| | SH.XPD.CHEX.GD.ZS | 2.8178754 | 0.8024538 | 0.000543 |
| SH.STA.ODFC.ZS | NY.GDP.PCAP.KD | -1.644e-04 | 6.581e-05 | 0.0133 |
| | SH.XPD.CHEX.PC.CD | 7.056e-05 | 8.965e-04 | 0.9373 |
| | SH.XPD.CHEX.GD.ZS | -7.203e-01 | 3.898e-01 | 0.0660 |
| SH.DYN.NCOM.ZS | NY.GDP.PCAP.KD | -2.153e-04 | 5.988e-05 | 0.000401 |
| | SH.XPD.CHEX.PC.CD | -2.436e-04 | 6.609e-04 | 0.712820 |
| | SH.XPD.CHEX.GD.ZS | -9.828e-03 | 2.192e-01 | 0.964285 |

Table 3: Statistical Analysis

- As shown in the above table, after applying the glm model to the target variable "SP.POP.65UP.TO.ZS," the variable "SH.XPD.CHEX.GD.ZS" has the greatest influence on the target variable, with an estimate of 8.782e-01 and a standard error of 1.687e-01. The variables "NY.GDP.PCAP.KD" and "SH.XPD.CHEX.GD.ZS" are both significant, with p values less than 0.05. As a result, it is useful for detecting trends.
- As we look for the next target variable "SH.STA.SMSS.ZS," we see that it is heavily influenced by the variable "SH.XPD.CHEX.GD.ZS," which has an estimate of 6.680e-01 and an estimate of 1.002. However, because the p-value is more than 0.05, this variable is not significant. The significant variable in this case is NY.GDP.PCAP.KD, with a p-value less than 0.05.
- SH.XPD.CHEX.GD.ZS, with an estimate of 2.81 and a standard error of 0.802, has the greatest influence on SH.STA.BASS.ZS. The p-value of the independent variable SH.XPD.CHEX.GD.ZS is also less than 0.05, showing that our predictor variable is very significant.
- SH.STA.ODFC.ZS is mostly influenced by the variable SH.XPD.CHEX.GD.ZS. However, as we can see from the p-value, it is more than 0.05, indicating that the influence is not significant. As a result, NY.GDP.PCAP.KD is the most influential variable, and it is even significant since its p-value is 0.0133, which is less than 0.05.
- SH.DYN.NCOM.ZS is heavily influenced by NY.GDP.PCAP.KD, which has an effect of -2.153e-04 and a standard error of 5.988e-05. This column is also noteworthy since it has a p-value that is less than 0.05.

In this part, we will examine the global trend and whether or not it is being followed at the country level. To get insights, we will look at three main kinds of nations, which are classified based on population.

## 3.2 Trends and Analysis

### 3.2.1 GDP per capita Vs Population ages 65 and above (% of total population)

Here We have data about 261 countries about GDP per capita and percentage of population of a country aged 65 and above in the year 2019.

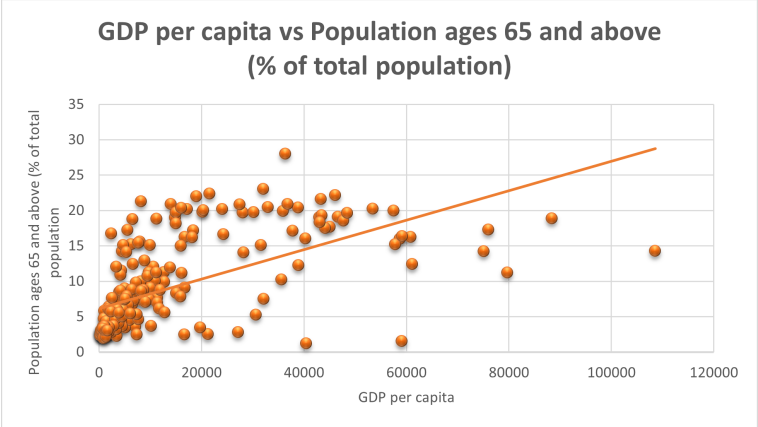


Figure 1: Population aged 65 and above at **global** level

As we can see, nations with lower GDP per capita have a lower proportion of individuals aged 65 and over, whereas countries with greater GDP have a higher percentage of persons aged 65 and up. We may also see that there are fewer nations with GDP per capita more than 1500. Sixty-four percent of nations have GDP of less than 279 dollar , whereas the average GDP per capita for all countries is 15655.

For example, Luxembourg has a GDP per capita of 108570 and 14.27% of its population is 65 and older, but India has a GDP per capita of 1972 and just 6.377% of its population is 65 and older. However, 6.37 percent of India's population is 87.7 million, which is 140% of the total population of Luxembourg. This is due to the fact that certain nations are extremely wealthy and have better lifestyle and health facilities, but in impoverished countries, the majority of the population cannot even afford the worst lifestyle of affluent countries. We shall now observe that the same pattern is being followed in various countries, but from a demographic standpoint.

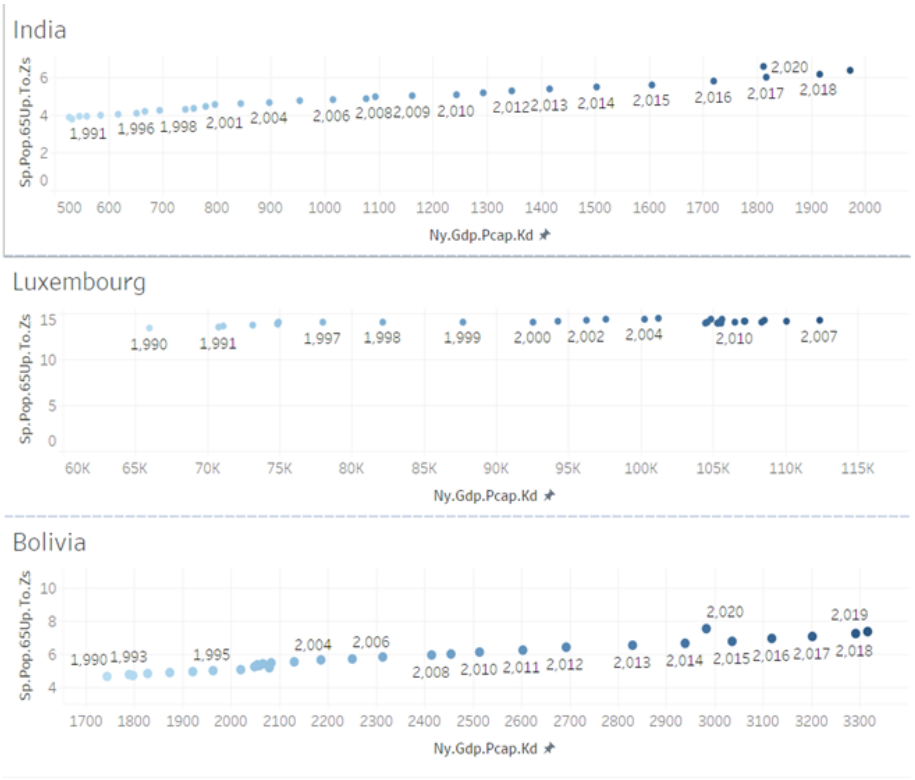


Figure 2: Population aged 65 and above at **country** level

India is a densely inhabited country, whereas Bolivia is sparsely populated and Austria has a relatively small population. We will examine these nations' criteria to see how they align with global trends.

As we can see, both India and Bolivia are following the same worldwide trend: as GDP per capita rises year after year, so does the proportion of individuals aged 65 and more. The data spans 31 years, from 1990 to 2020. As we can see, Bolivia's GDP in 1990 was almost comparable to India's GDP in 2020. There is a significant disparity in GDP per capita between the two nations because Bolivia's population is only 0.05% of India's population.There might also be a reason since Bolivia won independence in 1825 and India gained independence in 1947, more than 120 years later, which could be a role in the country's low GDP per capita.

Luxembourg has risen to become one of the world's wealthiest countries, owing to a thriving financial services sector, political stability, and European integration. As a result, its GDP per capita in 1990 was 30 times that of India's GDP per capita in 2020. As a result, it has superior health infrastructure and a better lifestyle for Luxembourg residents. During World War II, the nation was never governed by a country other than Germany. The GDP per capita fell during the Great Recession, which had an influence on life expectancy at the time. Nonetheless, being one of the world's richest countries, it was significantly

superior to the majority of the others.

### 3.2.2 GDP per capita Vs People using at least basic sanitation services (% of population).

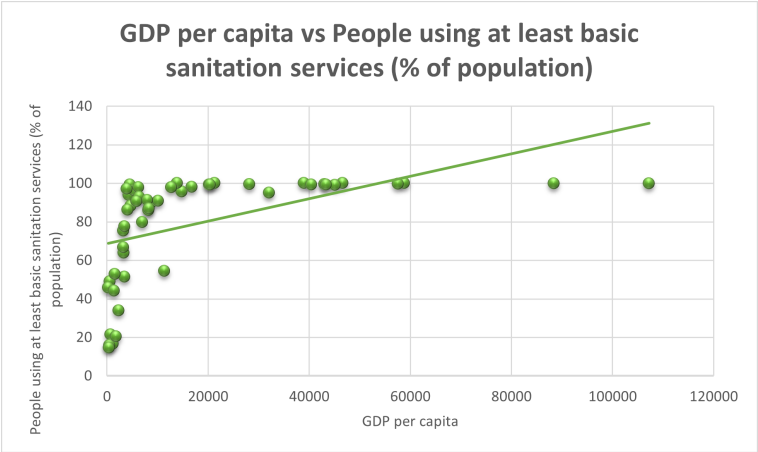


Figure 3: People using at least basic sanitation services at **global** level

As seen in the graph, nations with higher GDP per capita have a higher proportion of people who use basic sanitation facilities, whereas countries with lower GDP per capita have a lower percentage of people who use basic sanitation facilities.

In 45 percent of countries, 88% or more of the population has access to basic sanitation facilities. Another observation is that GDP per capita has minimal association with GDP per capita. We cannot discern anything conclusively by looking at the pattern of what economic factors are affecting people's access to basic sanitation services. We can also see Only 15 percent of people in 15 countries, mostly in Africa, have access to basic sanitation, accounting for less than 40% of the population.

We will investigate if the same trend is being observed at the national level in nations with varying populations.

The data given above is for all nations from 2000 to 2019.

- In Austria, where the population is only 8.9 million, there has been no change in the percentage of people using basic sanitation facilities during the last 20 years. As we can see, Austria's 100% population uses basic sanitary facilities from the beginning since Austria is a developed country with all of the essentials necessary by the people. It also has a high GDP per capita in 2000, which is over 39000, which is a significant amount. This also demonstrates that the basic lifestyle of all Austrians is a very excellent lifestyle. Furthermore, it is a wealthy country.

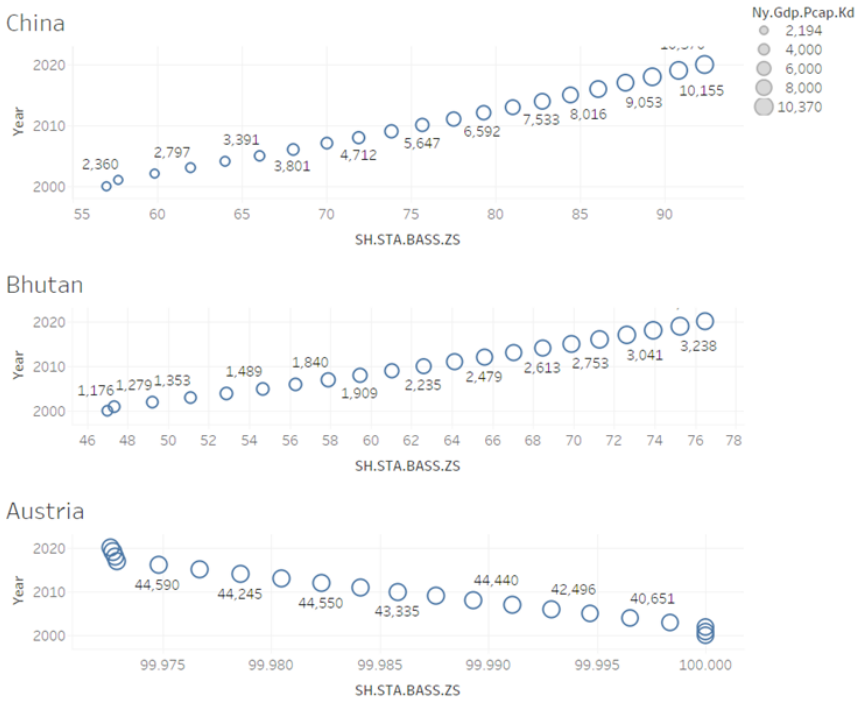


Figure 4: People using at least basic sanitation services at **country** level

- Bhutan is a tiny nation with a population of 0.76 million people that is following a worldwide trend in terms of the percentage of people utilising basic sanitation facilities growing year by year as GDP per capita rises. In the last 20 years, there has been a 63% rise in the number of people utilising basic sanitation services, while GDP per capita has increased by 160%. Bhutan's GDP per capita is 0.067% that of Austria's.
- China is the world's largest country, with a population of 1.43 billion people. China has lately become a powerhouse due to its massive manufacturing hub. As a result, we can witness a 5-fold growth in GDP per capita in 20 years, and the percentage of people utilising basic sanitation facilities grew from 57 to 92, which is really outstanding for a country of that size. This might be due to a shift in political power, new policies established, or investment in the correct areas. As a result, the average person's lifestyle has improved substantially during the last 20 years.

#### 3.2.3 Current Health Expenditure Vs Mortality from chronic disease)

In this section, we will examine how a rise in current health spending as a percentage of GDP of their country's growth affects death rates from chronic diseases such as cancer, diabetes, and so on for persons aged 30 to 70. As the graph plainly shows, nations with a larger percentage of their GDP devoted to health spending have a lower percentage of individuals dying from chronic

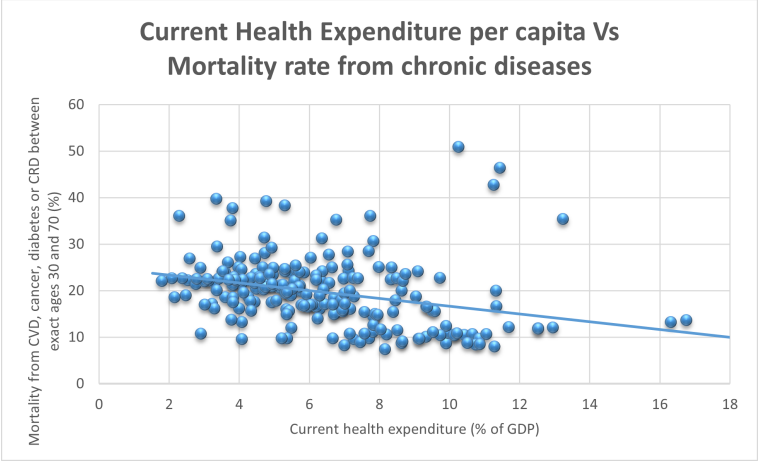


Figure 5: Mortality rate from chronic diseases at **global** level

illness.

Sixty percent of nations devote 3 to 6% of their GDP to health spending.We may identify certain outliers, such as Lesotho and Afghanistan, which had a high proportion of GDP spending but still had a higher percentage of persons dying from chronic illnesses, despite the fact that Lesotho has a population of 2.142 million and Afghanistan has a population of 40 million. We will learn more when we have in-depth discussions and look at trends at the national level in many countries.

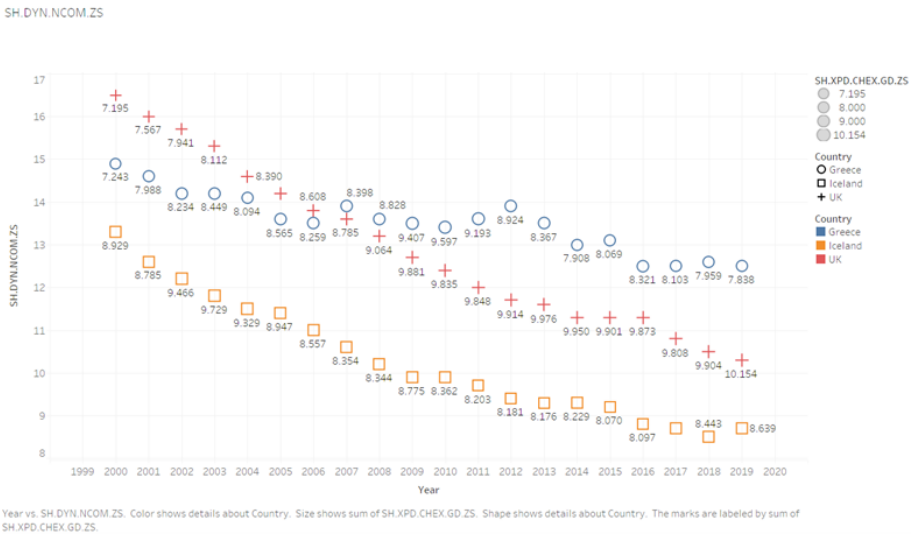


Figure 6: Mortality rate from chronic diseases at **country** level

The similar pattern can be seen in all nations, as health expenditure as a proportion of GDP is growing but the number of people dying from chronic illnesses is reducing year on year.

- With a population of 67.22 million people, the United Kingdom has a 2.7 trillion dollar GDP, up from 1.7 trillion dollars in 19 years, a 59 percent rise, and a population increase of just 2%, which is tremendous for a country with a smaller population. As a result, healthcare spending has risen from 7% to 10% in 19 years, accounting for a significant portion of the 2.7 trillion-dollar GDP. The reason for this is because they can spend a lot of money on health care, which is paying off because the rate of people dying from chronic diseases has dropped by 60%.
- Iceland is a small nation with a population of only 0.36 million people, and we can observe that while the proportion of allotment to health spending has reduced by 0.3%, their GDP has grown by 140%. It implies they have raised their health spending budget, resulting in a 46% reduction in chronic disease-related mortality among adults aged 30 to 70.
- Greece is a country with an average population of 10.72 million people. As shown in the graph, the percentage of GDP allocated to health spending is inversely proportional to the mortality rate of those dying from chronic illnesses. Its GDP has expanded by 32 percent in the previous 19 years, resulting in an increase in health spending and a 9.5 percent drop in the mortality rate of those dying from chronic illnesses.

### 3.2.4 Current Health Expenditure Vs People practicing open Defecation

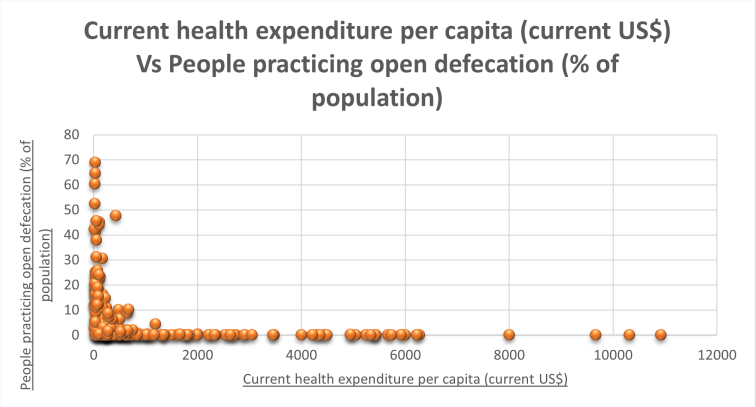


Figure 7: People practicing open defecation at **global** level

We can observe from the graph above that nations with health spending per capita ranging from 0 to 500 have individuals who practise open defecation. People who use open defecation are essentially non-existent in nations with health expenditures over 1000 dollars. In 57.6% of nations, just 0% to 7.5% of the population uses open defecation which is a good thing.

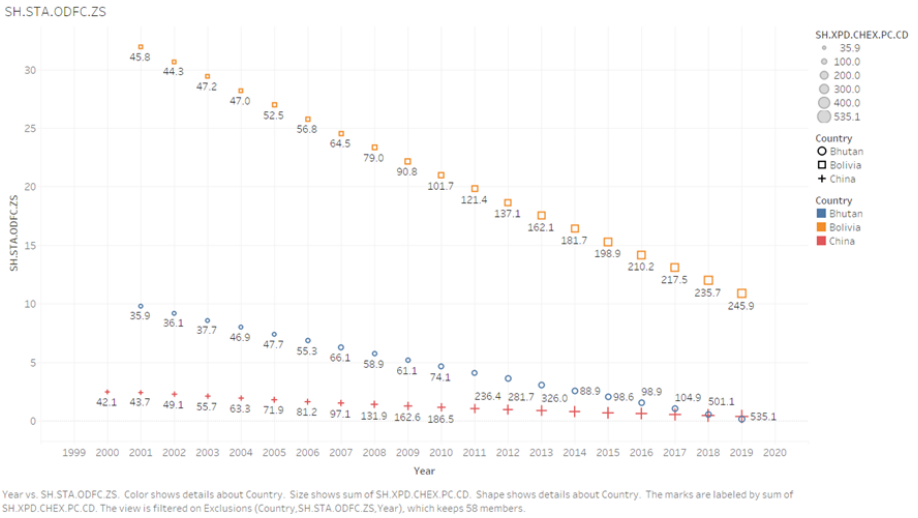


Figure 8: People practicing open defecation at **country** level

We can see the similar tendency here: while the country's health spending is expanding regardless of population, the percentage of persons who practise open defection has reduced dramatically.

- Bolivia, with a population of 11.67 million people, has a health expenditure per capita of 246 USD, up 435 percent in the previous 19 years, indicating that persons who use open defecation have reduced by 200 percent. This graph depicts the effects of rising health spending per capita on those who use open defecation. This leads to a healthier lifestyle and a disease-free environment.
- Bhutan is a tiny country with a population of 0.77 million people. Health expenditure per capita has grown fourfold, resulting in a tenfold reduction in the number of persons who practise open defecation. This also demonstrates how an increase in economic factors leads to a higher quality of life and improved health.
- China is a massive country with a population of 1.43 billion people. Their health expenditure per capita has grown about 13 times in the previous 19 years as a result of rising GDP and health spending. As a result, the percentage of persons who practise open defecation in their nation has fallen by 5.5 percent. Although the figure appears little, it represents more than 2.6 billion individuals. This demonstrates how economic expansion increases health variables.

# 4 Conclusion

Higher population growth rates would definitely lead to higher economic growth rates if population growth and per capita GDP growth are fully independent. It would still be true that, as Piketty (2014) points out, only increases in per

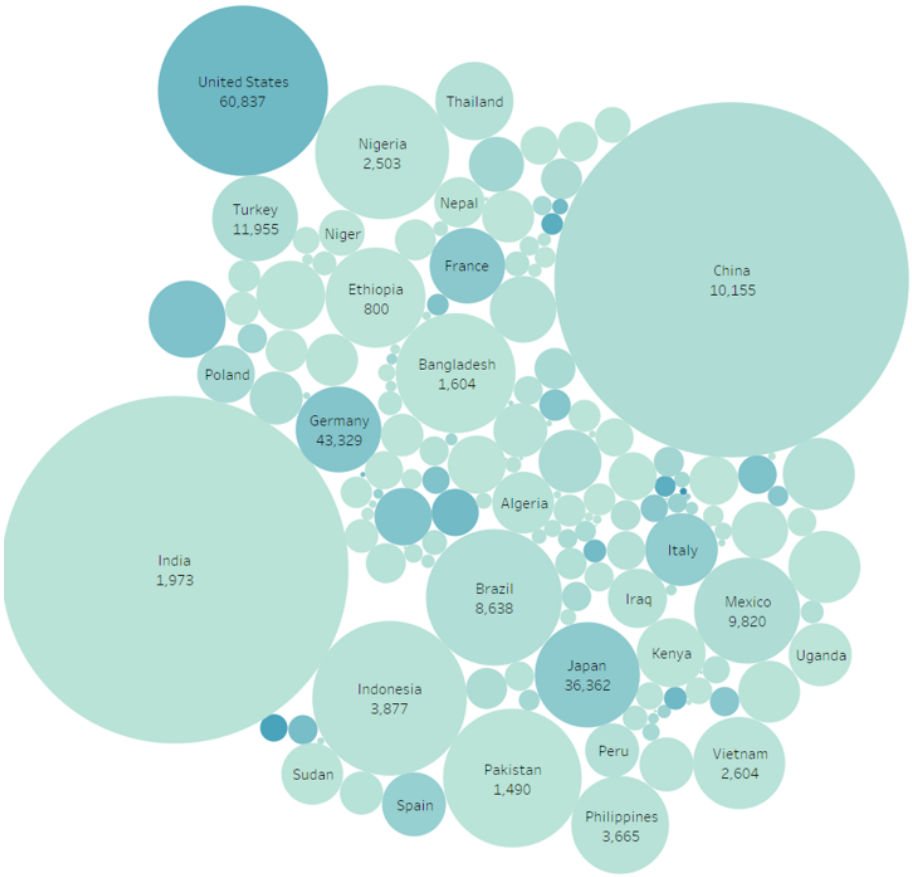


Figure 9: Population Size Vs GDP per capita

capita GDP lead to increases in economic well-being. If population increase has an impact on per capita output growth, higher population growth rates might lead to either higher or lower total economic growth, depending on the nature of the impacts on per capita GDP.

Based on Globe Bank (2017) statistics, the correlation between population growth and real per capita GDP growth for the world as a whole was 0.1849 from 1990 to 2015, indicating that the two variables were uncorrelated during that time. Of all, simple correlation reveals very little about the true relationship between these variables. Economists have created theoretical reasons that support both the assumption that population expansion slows per capita production growth and the opposing belief that population growth encourages higher economic growth.

One of the first and best-known hypotheses demonstrating that population expansion has a detrimental impact on well-being was created by Thomas Malthus (1993). He argued that because population growth outpaces food resources, population decreases through different forms of unhappiness are always necessary

to maintain the number of people in line with the amount of food available. Malthus' model implies that population expansion will always push average earnings down to a level that is only enough for the population's subsistence.We can get a idea of how the country's population and their GDP per capita differ by looking at above figure.[1]

As a result of the preceding study, we can conclude that population expansion causes GDP per capita and national income per capita to fall while GDP increases. We might also state that there is an evident association between economic characteristics and health issues on a worldwide basis, but this varies by country.

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