Analyzing the Impact of Temperature on Health

Introduction:

Main Question

How do variations in climate conditions impact mortality rates due to major chronic diseases from 2000 to 2019?

Description

major chronic diseases such as cardiovascular disease, cancer, diabetes, and chronic respiratory disease. By utilizing data from the Berkeley Earth Surface Temperature dataset and the World Health Organization (WHO) mortality data, the goal is to understand how fluctuations in temperature, precipitation, and other weather-related factors influence health outcomes. The analysis integrates data from these two sources to explore the impact of environmental factors on public health, aiming to provide insights into the potential health risks posed by climate change.

Used Data:

In this project, we utilize two key datasets to investigate the relationship between surface temperature anomalies and mortality rates due to major non-communicable diseases. The data sources and their characteristics are described below:

Global Surface Temperature Data

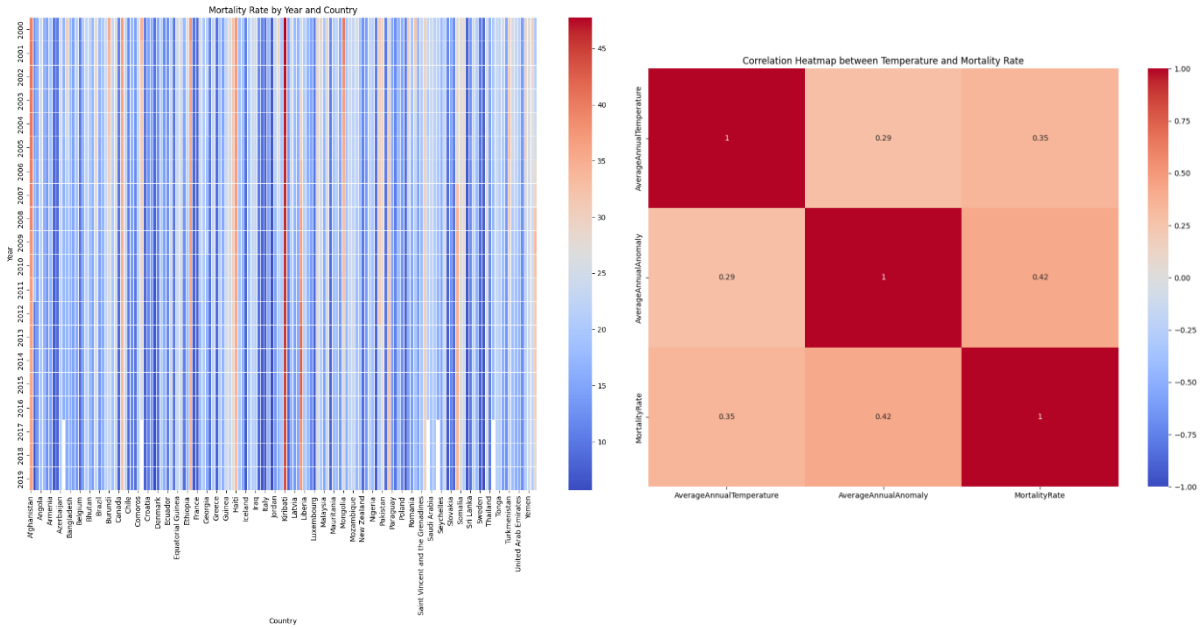
- **Source**: Kaggle
- **URL**: https://www.kaggle.com/datasets/josepferrersnchez/bearkley-earth-surface-temperature-data
- **Period**: 2000-2019
- **Description**: This dataset contains historical temperature data collected from various weather stations around the world. The data includes monthly average temperatures and temperature anomalies for each month from 1900 to the present day. Each record represents the temperature data for a specific country and month, allowing us to analyze trends and patterns over time.
- **License**: Public Domain (CC0)

Mortality Rates due to Non-Communicable Diseases

- **Source**: WHO
- **URL**: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/probability-(-)-of-dying-between-age-30-and-exact-age-70-from-any-of-cardiovascular-disease-cancer-diabetes-or-chronic-respiratory-disease
- **Period**: Data available till 2019
- **Description**: This dataset provides mortality rates for individuals aged 30 to 70 due to major non-communicable diseases such as cardiovascular disease, cancer, diabetes, and chronic respiratory disease. The data is collected from various countries and includes information on the year and the specific mortality rate for each country, which helps in understanding the health impact over different periods.

To perform a comprehensive analysis, we integrate the temperature and mortality datasets based on the country and year. The integrated dataset allows us to explore correlations and trends between temperature anomalies and mortality rates, providing insights into the potential impact of climate change on public health.

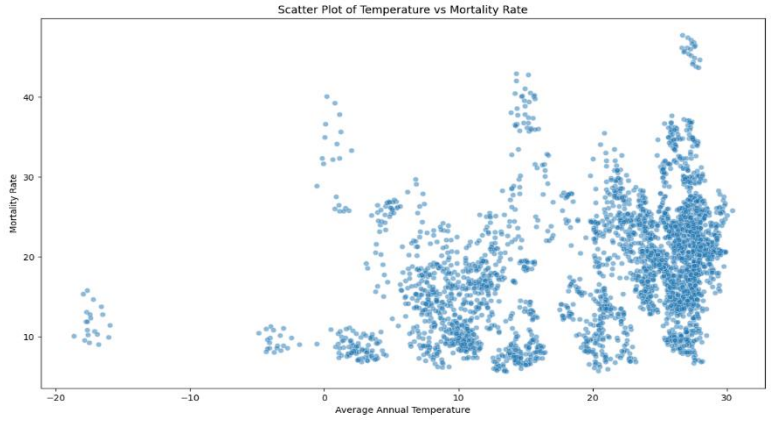
Analysis:



Heatmap of Mortality Rate by Year and Country : The first heatmap visualizes the mortality rate across various countries from the year 2000 to 2019. The color intensity represents the mortality rate, with higher rates shown in red and lower rates in blue. This heatmap provides a clear overview of how mortality rates have varied over time and geography. Some countries show consistently high mortality rates, while others have seen significant changes over the two decades. This information can be crucial for public health officials to identify regions requiring more focused health interventions.

Correlation Heatmap between Temperature and Mortality Rate: The second heatmap shows the correlation between average annual temperature, average annual temperature anomaly, and mortality rate. The correlation values range from -1 to 1, where values closer to 1 indicate a strong positive correlation, and values closer to -1 indicate a strong negative correlation. Here, we observe:

- A moderate positive correlation (0.35) between average annual temperature and mortality rate, suggesting that higher temperatures may be associated with higher mortality rates.
- A stronger positive correlation (0.42) between average annual temperature anomaly and mortality rate, indicating that deviations from the norm (either warmer or cooler) have a significant impact on mortality rates.

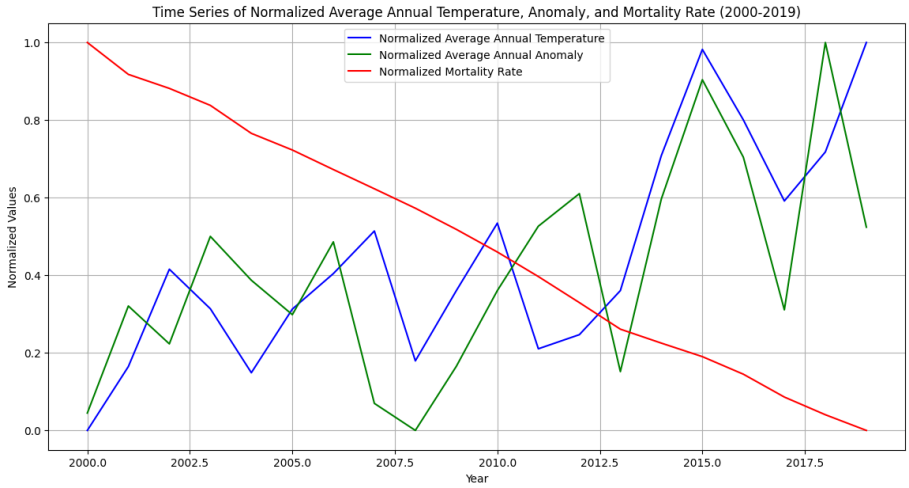


Temperature vs. Mortality Rate

This scatter plot showcases the relationship between average annual temperature and mortality rate across various countries from 2000 to 2019. The graph reveals significant variability in mortality rates corresponding to different temperature ranges. Noticeable clusters around specific temperature bands (e.g., 0-10°C, 20-30°C) indicate regional or climatic patterns that influence mortality rates. Outliers with high mortality rates (>30) highlight exceptional cases.

Key Observations:

- **Distribution and Clustering:** Data points are widely dispersed, indicating a weak positive correlation between higher temperatures and increased mortality rates. Clustering at specific temperature ranges suggests regional or climatic influences.
- **Outliers:** High mortality rate outliers underscore the variability in factors beyond temperature, such as regional healthcare quality and socio-economic conditions.



The time series plot of normalized average annual temperature, average annual anomaly, and mortality rate from 2000 to 2019 highlights several key observations.

Firstly, the mortality rate due to non-communicable diseases (NCDs) shows a consistent decline over the period, while the average annual temperature and temperature anomaly exhibit significant fluctuations. This indicates that while mortality rates are decreasing, the variations in temperature and anomaly are more erratic.

Secondly, the plot reveals that the general trend of increasing temperatures and anomalies does not directly correlate with the declining mortality rates. This suggests that other factors, potentially including advancements in healthcare, policy interventions, and socio-economic improvements, might have a more substantial impact on reducing premature mortality from NCDs than temperature changes alone.

Lastly, the significant yearly variations in temperature and anomaly underscore the complexity of isolating the direct impact of climate change on mortality rates. Further research is necessary to disentangle these effects and to understand how rising temperatures might indirectly influence health outcomes through environmental, economic, and social pathways.

Conclusion

This study investigates the impact of rising temperatures, a consequence of climate change, on the premature mortality rate due to non-communicable diseases (NCDs) in various countries between 2000 and 2019. By integrating data from the Berkeley Earth Surface Temperature dataset and WHO mortality data, we aim to understand the correlation between temperature variations and mortality rates.

Our analysis reveals several key insights:

1. **Heatmap of Mortality Rate by Year and Country**:
    - The heatmap shows significant variation in mortality rates across different countries and years. Some countries have persistently high mortality rates, while others have seen marked improvements. This geographic and temporal variability highlights the importance of targeted health interventions and policies tailored to specific regions.
2. **Correlation Heatmap between Temperature and Mortality Rate**:
    - A moderate positive correlation (0.35) exists between average annual temperature and mortality rate, indicating that higher temperatures may be associated with increased mortality rates.
    - A stronger positive correlation (0.42) between average annual temperature anomaly and mortality rate suggests that deviations from normal temperature patterns (both higher and lower) significantly impact mortality rates.
3. **Scatter Plot of Temperature vs. Mortality Rate**:
    - The scatter plot illustrates the complex relationship between average annual temperature and mortality rate. Data points are widely dispersed, with clusters indicating regional or climatic patterns influencing mortality rates. Outliers with high mortality rates emphasize the variability in factors beyond temperature, such as healthcare quality and socio-economic conditions.
4. **Time Series Plot of Normalized Average Annual Temperature, Anomaly, and Mortality Rate**:
    - This plot shows a consistent decline in mortality rates over the study period, despite significant fluctuations in temperature and anomaly. This trend suggests that advancements in healthcare, policy interventions, and socio-economic improvements may have a more substantial impact on reducing premature mortality from NCDs than temperature changes alone.
    - The yearly variations in temperature and anomaly underscore the complexity of isolating the direct impact of climate change on mortality rates. The lack of a direct correlation between rising temperatures and declining mortality rates indicates that other factors play a crucial role in influencing health outcomes.

In conclusion, while our study highlights a notable relationship between temperature variations and mortality rates due to NCDs, it also underscores the importance of considering a broader range of factors, including healthcare improvements and socio-economic conditions. Further research is needed to fully understand the indirect effects of climate change on health outcomes and to develop comprehensive strategies for mitigating these impacts.