Executive Summary: Global Climate Factors and Their Impact on Human Disease Burden

Contributors

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Objective

This study investigates how climate change factors affect health risks across countries with varying environmental and socioeconomic conditions. Our goals with our research was to help inform government healthcare planning, help advocate for climate change policies, and to contribute to the research on the effects of climate change.

Data & Methodology

We merged two datasets to accomplish our objectives:

1. Global Climate-Health Impact Tracker (GCHIT): https://www.kaggle.com/datasets/sohumgokhale/global-climate-health-impact-tracker-2015-2025
2. Global Burden of Disease (GBD): https://vizhub.healthdata.org/gbd-results/

Our merged dataset provided us with the opportunity to examine weather and climate-related (e.g. air quality, temperature, precipitation, extreme weather) data with global burden of disease data for 24 countries between 2015 to 2025. Preprocessing included input error corrections, normalization, Box-Cox transformations, and one-hot encoding for nominal categorical fields. Feature engineering such as adding rolling averages as new columns and temporally lagging features was also conducted. Models included simple linear regressions, regularized approaches, and tree-based models which were all trained on time-series splits of the dataset. Visualizations were also heavily used to provide an intuitive grasp of how the data behaved.

Key Findings

Climate-Disease Relationships

- Infectious and vector-borne diseases demonstrated strong climate sensitivity with temperature, precipitation, and extreme weather. Our best performing models for this explained ~96% variance ($R^2 \approx 0.96$).
- Respiratory diseases were motivated primarily by air pollution (PM2.5, air quality index), not climate factors. Our climate-only models had lower explanatory power at $R^2 \approx 0.46$.
- Cardiovascular diseases showed minimal correlation with climate factors ($r < 0.15$).

Income & Environmental Disparities

- Higher-income countries were associated with lower pollution and disease burden when compared to lower-income countries. This could be a confounding variable influencing both pollution and disease, creating an illusion of higher correlation than directly exists.

Model Performance

- Heat-related admissions demonstrated strong predictive accuracy ($R^2 \approx 0.79$).
- Vector-borne disease predictions were very good, especially after feature engineering ($R^2 \approx 0.91$).
- Infectious disease rates could be predicted very accurately ($R^2 \approx 0.96$).
- Respiratory disease had moderate performance ($R^2 \approx 0.58$).
- Cardiovascular disease possessed moderate performance ($R^2 \approx 0.56$).
- Mental health models had little-to-no predictive power using climate factors.

Limitations

Several limitations should be noted while interpreting our results. We only had access to national-level annual averages in the GBD dataset, which obscured seasonal and regional patterns. We were also missing some key factors that could impact disease burden (e.g., smoking prevalence, healthcare capacity). Finally, these findings should be interpreted as associations for the time being, not necessarily causal linkages.

Conclusions and Recommendations

- Climate change heavily influences infectious and vector-borne diseases.
- Respiratory diseases are instead primarily pollution-driven.
- Cardiovascular diseases remain largely climate-insensitive.
- Income mitigates but does not completely negate climate-related health risks.

Climate factors must be embedded in health strategies to prepare for rising disease burdens under global climate change. Future work should be done with more granular data, the addition of healthcare metrics, and advanced models to capture complex interactions. Government officials should align policies with climate-health considerations while attempting to fight climate change.