

Demographic Insights into Disease Patterns: An Interactive Visualization Approach

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Population pyramids provide a comprehensive, multidimensional perspective of demographic structures by capturing age and sex distributions, revealing complex patterns critical for identifying public health vulnerabilities. These insights are especially valuable for understanding age-related diseases and disparities in healthcare access among diverse populations. We present an interactive interface that utilizes population pyramid structures to analyze disease-specific mortality patterns. This tool enables researchers and policymakers to explore how demographic variations impact disease burdens and to compare these insights with traditional demographic and economic indicators, supporting more informed public health analysis and decision-making. The system integrates two novel metrics from recent literature: PopDivergence, measuring the Kullback-Leibler (KL) divergence between population pyramids, and PoPStat, representing the Pearson correlation between PopDivergence and cause-specific mortality. These metrics quantify demographic divergence and its relationship with mortality. We apply these metrics to an extensive dataset spanning 180 countries and 371 disease types from 2015 to 2021. The interface also incorporates comparative visualizations of seven key demographic and socioeconomic indicators: Human Development Index (HDI), GDP per capita, life expectancy, Gini coefficient, median age, population density, and the Universal Health Coverage Index (UHCI). The user interface provides an interactive platform to visualize disease-specific correlations and compare them with traditional health indicators. It shows how various population pyramid types such as expansive, regressive, or stationary, relate to specific diseases using statistical measures. The analysis reveals that NCDs like cardiovascular diseases are more prevalent in regressive populations, while infectious diseases dominate in expansive ones. It also shows that injuries tend to be demography-independent. The interface identifies high-risk demographic groups and highlights how shifts in population structure influence disease burden. It transforms complex population data into accessible visualizations, supporting data-driven decisions, targeted interventions, and improved epidemiological insight. It enhances public health strategies by enabling professionals to explore demographic-disease relationships and visualize which population types are most associated with specific diseases, promoting more effective and equitable policymaking.

Keywords: Population pyramids, public health, demographics, PoPStat, PopDivergence