Scaling and Spatial Analysis of External Causes of Death: Accidents, Suicides, and Homicides in Brazilian Cities

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This study investigates the relationship between population size and mortality from external causes of death—specifically accidents, suicides, and homicides—in Brazilian cities between 2009 and 2020. Using the scaling relation $DC \sim Pop^{\gamma}$ [1], where DC represents the number of death certificates and Pop represents the city population, we explore how these external causes of death vary across different population sizes [2].

Our results show that accidents maintain an isometric relationship ($\gamma = 1$) with population size throughout the analyzed period, indicating a proportional relationship between accidents and population. Suicides exhibit a sublinear allometric relationship ($\gamma < 1$), suggesting that smaller cities experience disproportionately higher suicide rates [3]. Homicides, however, display a more complex pattern: while they initially follow a superlinear trend ($\gamma > 1$) in larger cities, they transition to an isometric trend in the final years of the time series. This shift points to a broader restructuring of social interactions and urban dynamics influencing violent crime in Brazilian cities.

To confirm the robustness of these findings, we analyzed the probability distribution curves for each cause of death, finding consistent allometric exponents across the series. Additionally, spatial correlation analysis revealed different patterns for each external cause. Accidents and suicides exhibit a rapid decay in spatial correlation, consistent across all years, while homicides display a slower decay, particularly in the intermediate and final years, accompanied by an increasing characteristic spatial correlation length. These insights provide a deeper understanding of how population size and urban social dynamics influence external mortality causes. The observed shift in homicide behavior highlights the evolving nature of violence in urban settings, and our findings have significant implications for public policy aimed at reducing mortality from external causes in cities of varying sizes.

References

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