The Impact of Income on Cardiovascular Disease Mortality Rates: A Socioeconomic Analysis

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Introduction

- Cardiovascular Disease (CVD) is the most common chronic disease and cause of death in the United States[1]
- West Virginia has one of the worst overall health outcomes in the country[2]
- West Virginia healthcare funding allocation is based upon county level information[3]
- A known modifiable risk factor that worsens CVD mortality is income[4]
- This analysis is part of an overarching study aimed at identifying if multiple risk factors lead to a significant increase in CVD death rates than compared to each individually

Methodology

- Median household income data for all counties in West Virginia from 2011 to 2020 were obtained from the U.S. Census Bureau's American Community Survey.
- An $x^{-0.14}$ transformation was applied to normalize the income data, achieving a Gaussian distribution as verified by visual inspection of Q-Q plots.
- No significant outliers were identified post-transformation.
- A linear regression analysis was conducted to evaluate the association between income levels and CVD mortality rates. Statistical significance was defined as $p < 0.05$ (two-tailed).

Results

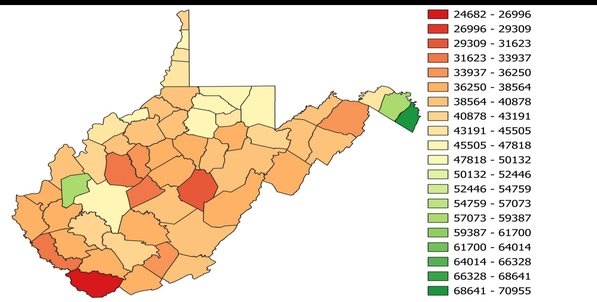

Figure 1: Heatmap of Median Household Income in each county of West Virginia

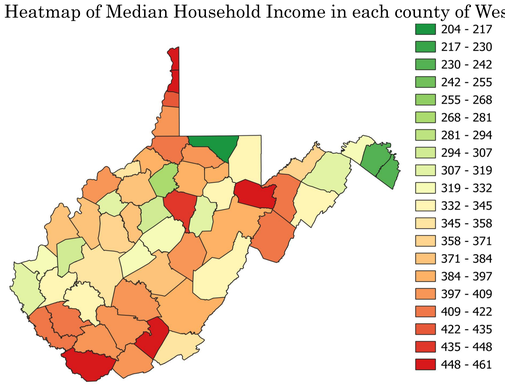

Figure 2: Heatmap of the average number of deaths per 100,000 people in each county of West Virginia

Results

- The linear regression model demonstrated a significant association between income and CVD mortality ($F(1,537) = 53.39$, $p < 0.0001$).
- CVD death rate = 8227*(Income) – 1122 (95% CI: [6023, 10431], $t = 7.33$, $p < 0.0001$).
- Additionally, a significant negative correlation was observed between median household income and per capita CVD mortality ($r = -0.2104$, 95% CI: [–0.2889, –0.1290], $p < 0.001$).
- Visual inspection of an overlaid heatmap revealed a trend: counties located closer to metropolitan areas exhibited lower CVD mortality rates.

Conclusion

- The results demonstrate a significant inverse correlation between median household income and cardiovascular disease mortality in West Virginia
- .These findings emphasize the role of socioeconomic status as a potentially modifiable risk factor.
- The data suggest that proximity to metropolitan areas is associated with better cardiovascular outcomes, likely due to greater access to higher-paying careers.
- Overall, these findings highlight the need for further research into income-focused public health interventions and geographic targeting of areas with the greatest need.

References

1. Gebreab SY, Davis SK, Symanzik J, Mensah GA, Gibbons GH, Diez-Roux AV. Geographic Variations in Cardiovascular Health in the United States: Contributions of State- and Individual-Level Factors. *J Am Heart Assoc*. 2015;4(6):e001673. doi:10.1161/JAHA.114.001673
2. Radley DC, Baumgartner JC, Collins SR, Zephyrin L. The Commonwealth Fund 2023 Scorecard on State Health System Performance: Americans' Health Declines and Access to Reproductive Care Shrinks, But States Have Options. Published online 2023. doi:10.26099/FCAS-CD24
3. W. Va.. code R. § 64-116-4 - Formula; allocation of funds; distribution. Legal Information Institute. Accessed May 5, 2025. https://www.law.cornell.edu/regulations/west-virginia/W-Va-C-S-R-SS-64-116-4.
4. Lemstra M, Rogers M, Moraros J. Income and heart disease: Neglected risk factor. *Can Fam Physician Med Fam Can*. 2015;61(8):698-704.

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