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Introduction

Global climate change has led to changes in human disease patterns. In particular, rising temperatures, higher UV indices, thinning of the ozone layer, air pollution and sun-exposure-related behavioral changes have been linked to higher melanoma incidence.¹ It has been theorized that these environmental changes affect surface UV exposure leading to DNA damage, increase oxidative stress, and disrupt the skin barrier, leading to increased risk of skin cancer.¹ With climate change patterns exacerbating globally, systemic efforts to prevent skin cancer will be needed.

Objectives

This study examines associations between state-level climate indicators including temperature, sunlight, and rainfall, and melanoma mortality rates across the United States in 2018 and 2024.

Materials and Methods

State-level melanoma death rates for 2018 and 2024 were obtained from the CDC WONDER database using ICD-10 code C43, representing malignant melanoma of the skin.² Climate data including average annual temperature, sunny days per year, and total rainfall were collected using the Open-Meteo weather database.³ Pearson and partial correlations were computed cross-sectionally and over time, controlling for latitude to account for population differences across states.⁴ Heatmaps to display differences in age-adjusted mortality, annual average temperature, days of sunlight, and annual precipitation from 2024 to 2018 were generated in R using usmap, which uses U.S. map/state boundary data derived from U.S. Census TIGER/Line shapefiles.⁵

Results

Crude melanoma death rates overall declined from 2.76 to 2.68 per 100,000 between 2018 and 2024, and age-adjusted rates declined from 2.24 to 2.08 per 100,000, though 24 of 50 states saw increases. Warmer states initially appeared to have lower mortality, but this disappeared after controlling for latitude (partial $r = +0.01$, $p = 0.95$), confirming it reflected population differences rather than a true climate effect. States gaining more sunny days between 2018 and 2024 showed modest decreases in crude mortality after controlling for latitude (partial $r = -0.29$, $p = 0.039$). Rainfall showed no significant associations.

Difference in Age-Adjusted Mortality per 100K by State from 2024-2018

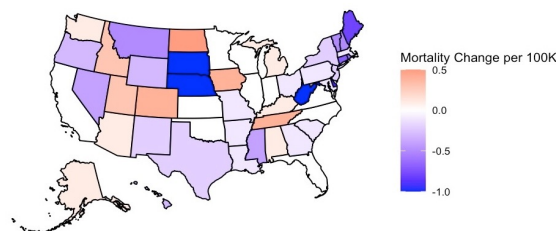


Figure 1 – Difference in Age-Adjusted Mortality per 100K from 2024 to 2018 in the U.S.- Differences in age-adjusted mortality varied, with states such as South Dakota and Nebraska with lower mortality rates in 2024, and states such as North Dakota with higher mortality in 2024 compared to 2018.

Difference in Annual Average Temperature (°F) by State from 2024-2018

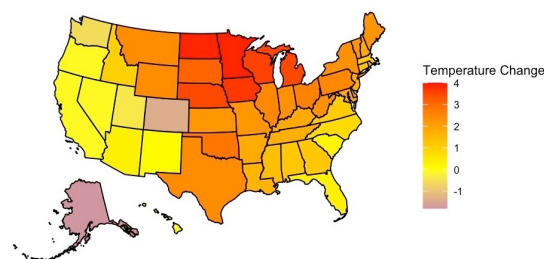


Figure 2 – Difference in Annual Average Temperature (°F) from 2024 to 2018 by U.S. State- There was high variability in annual average temperature change, with most increases seen in the Midwest, such as in Minnesota and Wisconsin.

Difference in Number of Days of Sunlight by State from 2024-2018

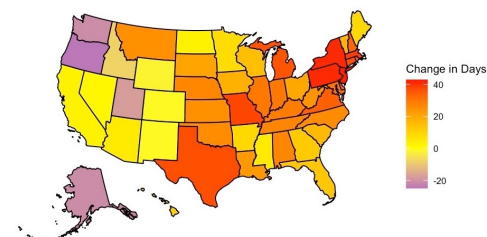


Figure 3 – Difference in Number of Sunny Days from 2024 to 2018 by U.S. State- Variability seen across the country, with less sunny days in the Pacific Northwest in 2024.

Difference in Annual Precipitation (inches) by State from 2024-2018

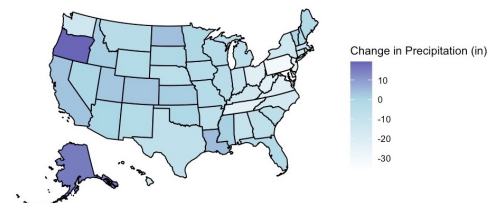


Figure 4 – Difference in Annual Precipitation (in) from 2024 to 2018 by U.S. State- Increased precipitation was most notable in Oregon & Alaska in 2024 compared to 2018.

Conclusion

Climate factors alone may not explain differences in melanoma death rates between states. Temperature effects could be explained by geographic and population differences. Sunlight showed a modest but consistent signal. Limitations of this study include that it is an ecological study, and therefore causation and confounding variables cannot be easily assessed. Future research incorporating UV exposure, skin type distributions, screening rates, and healthcare access is needed to better understand how climate change affects melanoma mortality.

References

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