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Introduction & Objectives

The COVID-19 pandemic has affected populations worldwide with disparities evident in the incidence, prevalence, and resultant mortality. A factor in such disparities may be the impact of social determinants of health (SDOH) on patient outcomes.

SDOHs are non-medical factors (e.g., socio-economic status) that influence health outcomes.¹ An understanding of the impact of SDOHs on patient outcomes is vital to improving patient outcomes and health equity within the United States.

The purpose of this research was to explore the relationship between SDOHs and hospital capacity, a surrogate dependent variable for patient outcomes (e.g., mortality) as indicated within Eriksson et al. (2017).²

Methods

By matching zip code and/or census tracts, three datasets (U.S. HHS "COVID 10 Report Patient Impact and Hospital Capacity by Facility" (12/12/2020 – 03/28/2022), HUS USPS Zip Code Crosswalk File, NaNDA "Socioeconomic Status and Demographic Characteristics of Census Tracts, United States") were merged to form a dataset of admitted COVID-19 cases, hospital capacity, socioeconomic (e.g., household income) and demographic (e.g., proportion of Hispanic households) data based on geography.

Kendall's rank correlation was used to assess the relationship between COVID-19 hospital capacity and SDOH variables as both variables were continuous and not normally distributed. Using STATA, the impact of three SDOH variables (race, education, household income) on five measures of COVID-19 hospital capacity strain (the proportion of beds used by COVID-19 patients, where a higher value means more patients are hospitalized): Total Capacity, Inpatient Capacity, ICU Capacity, Adult Capacity, and Pediatric Capacity.

T-tests between categorical SDOH variables and the hospital capacity outcomes were also run. The categorical variables are whether a tract was >57.8% White, based on the prevalence of White, non-Hispanic individuals in the U.S., whether 50% of adults in the tract have a high school diploma, and whether the tract is a micropolitan or metropolitan area of ≥10,000 people.^{3,4} The income categorical variable is whether ≥40% of households in the tract make <\$30,000 annually, based on the high-poverty neighborhood definition.⁵

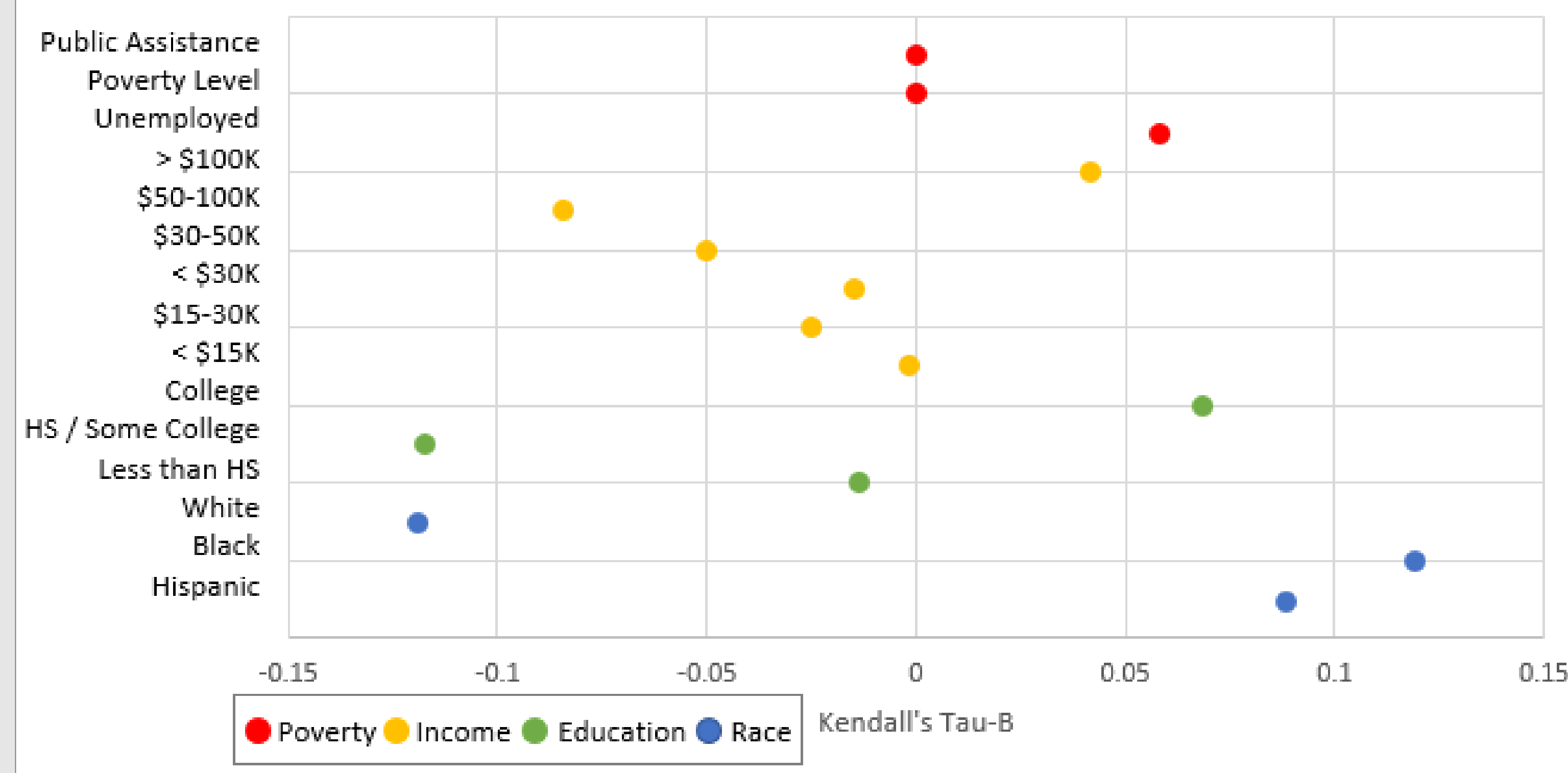


Figure 1 | Kendall's Tau-B Values* for SDOH Variables and Total Capacity

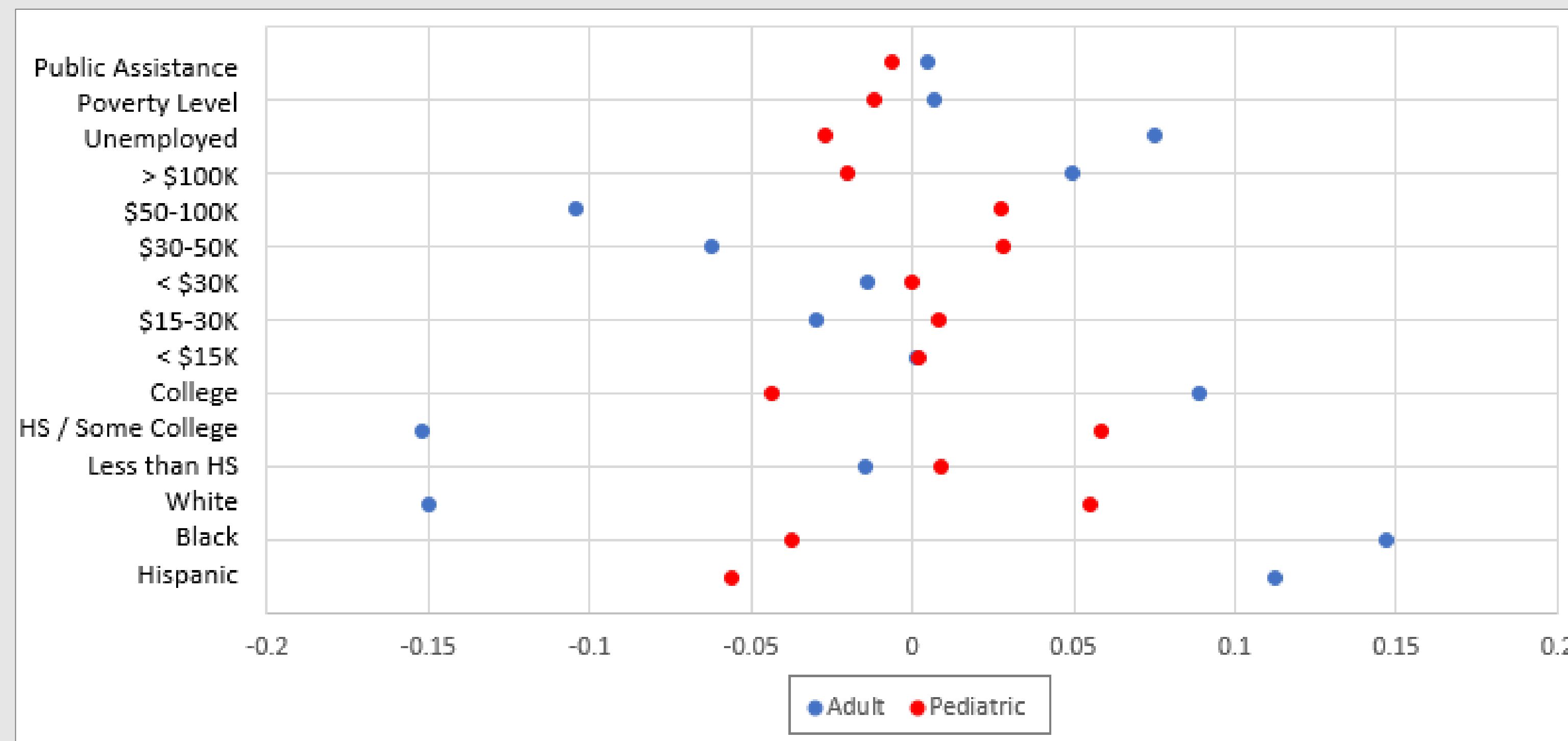


Figure 2 | Kendall's Tau-B Values* for SDOH Variables and Adult vs. Pediatric Capacity

The magnitude of the impact of SDOH variables is greater for adult-specific hospital capacity than for total capacity, which is probably due to increased hospitalizations rates and severity of COVID-19 symptoms in adults versus children.⁶

*All Kendall's correlation coefficients reported are statistically significant ($p < 0.005$).

Results

Race Analysis:

Percentage of Black and Hispanic families is positively correlated with total, adult, inpatient, and ICU capacity strain while percentage of White families is negatively correlated with those outcomes.

Additionally, having a proportion of White families that is less than 57.8% is negatively correlated with hospital capacity strain (total, adult, inpatient, and ICU).

Education Analysis:

Contrary to hypotheses, completing less than high school or college is negatively correlated with total, adult, inpatient, and ICU capacity strain while college completion is positively correlated with these outcomes.

Household Income Analysis:

Also contrary to hypotheses, incomes less than \$100K are negatively correlated with total and inpatient capacity strain, while incomes over \$100K are positively correlated with these measures. It is worth noting that incomes less than \$30K are positively correlated with ICU capacity strain.

Proportion of people unemployed and below the Federal Poverty Line (FPL) are positively correlated with total, adult, inpatient, and ICU capacity strain. Percent of families being on public assistance is positively correlated with adult, inpatient, and ICU capacity strain.

Metropolitan vs. Micropolitan Analysis:

A negative t-value in tests conducted with all capacity variables, living in a micropolitan or metropolitan tract of ≥10,000 people is negatively correlated with hospital capacity strain, suggesting that people living in rural or less populated areas face more severe COVID-19 related hospital capacity strain.

Conclusions

Research has established that social determinant of health inputs such as race, income, and education, are a factor in patient health outcomes.¹ Additional research by Eriksson et al. suggests that patients being treated at hospitals with less capacity also have worse patient outcomes.² This research seeks to draw the connection between social determinants of health contributing to increased hospital capacity strain during COVID-19 and, as a result, worse patient outcomes. Based on previous research, positive correlations between the proportion of Hispanic and Black residents, lower household income (e.g., less than \$50K), lower education levels (e.g., less than high school), and capacity strain variables were expected. However, the results of the analysis did not support all initial hypotheses with negative correlations observed between lower education levels, household incomes below \$100K and capacity strain variables.

Within the research, there are several confounding variables that may have contributed to the unexpected results. Regarding the negative correlation between lower education levels and capacity strain variables, a lack of education / understanding regarding health practices may influence individuals to not seek hospital care. Likewise, the negative correlation between lower income and capacity strain may be due to lower education levels (achieving entry level positions vs. higher paying roles which require graduate degrees), a lower average age and resultant healthier population (e.g., young adults starting their professional career), decreased job security and concern regarding the impact of missing work to seek medical care, or residency in areas with fewer hospitals and physicians.⁷ In addition to the potential confounding variables explored above, it is also important to acknowledge the distrust of healthcare institutions felt by some minority groups (e.g., Black, Hispanic) which may result in a decreased utilization of hospitals even if afflicted with COVID-19.⁸

Statistically significant correlations between SDOH variables and hospital capacity imply that patient outcomes may be disproportionately impacted due to hospital capacity with certain SDOH groups. However, additional research is required due to the presence of confounding variables as well as unexpected trends. COVID-19 has made the effect of SDOHs on patient outcomes more visible and addressing hospital capacity in areas with higher prevalence of SDOHs may improve patient outcomes in COVID-19 and other health areas.

References

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Abbreviations

HHS: Health and Human Services; HUD: United States Department of Housing and Urban Development; ICU: Intensive Care Unit; FPL: Federal Poverty Line; NaNDA: National Neighborhood Data Archive; SDOH: Social Determinants of Health; USPS: United States Postal Service