Challenges of Trustable AI and Added-Value on Health
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Covid-19 Positivity Differences Among Patients of a Rural, Southern US State Hospital System Based on Population Density, Rural-Urban Classification, and Area Deprivation Index

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Abstract: In this study we examined the correlation of COVID-19 positivity with area deprivation index (ADI), social determinants of health (SDOH) factors based on a consumer and electronic medical record (EMR) data and population density in a patient population from a tertiary healthcare system in Arkansas. COVID-19 positivity was significantly associated with population density, age, race, and household size. Understanding health disparities and SDOH data can add value to health and the creation of trustable AI.

Keywords. Social Determinants of Health, COVID-19, Area Deprivation Index, Rural-Urban classification

1. Introduction

Arkansas' rural population face more socio-economic challenges than urban areas, which may increase COVID-19 infection risk. [1] The objective of this study was to assess the association of Area Deprivation Index (ADI), population density, and demographic factors on COVID-19 positivity among the urban versus rural subjects.

2. Methods

The study population consists of patients active in the tertiary healthcare system in 2020, defined as patients seen within the last 3 years (2017 to 2020) collected from the electronic medical record (EMR) in 2020. The study's SDOH (social determinants of health) data was from the Acxiom database which is composed of compiled consumer data. It was linked with EHR data collected in 2020 using name, address and date of birth.

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A Spearman rank correlation was performed on COVID-19 positivity by zip code, ADI national rank, and population density (number of people per square mile). The subject population was separated into urban and rural groups, and COVID-19 positivity was defined as a patient that had COVID-19 at any time (yes/no). A logistic regression was used to estimate the impact of SDOH and population density on COVID-19 positivity for urban and rural groups. An $\alpha < 0.05$ was used to determine significance.

3. Results

There was a statistically significant relationship between COVID-19 positivity and population density by zip code in urban and rural groups with higher population density correlated with increased COVID-19 percent positivity (rho: rural 0.22, urban 0.39). ADI national rank was not statistically significant. The odds of COVID-19 positivity were lower in renters (Odds Ratio (OR): urban 0.85, rural 0.75), older age groups (30-64 (OR: urban 0.31, rural 0.46), 65+ (OR: urban 0.12, rural 0.21)), and a household size of two (OR: urban 0.76, rural 0.51). However, COVID-19 positivity was higher in the rural, Black population compared to the urban population (OR: urban 0.3, rural 2.0). In the urban population, no children present (OR: 0.76) had statistically significantly lower odds.

4. Discussion

This study found a significant association between population density and COVID-19 percent positivity for both urban and rural areas. This reflects findings of the early 2020 COVID-19 pandemic. [2] Some of the SDOH factors did not follow the expected pattern of increased COVID-19 positivity with worsening SDOH conditions. [3] This might mean that rural and urban areas have different risk factors for COVID-19 infection, which requires more exploration as these differences may impact AI models and improve explainability. The limitations to this study are generalizability due to the study population being from one hospital system.

5. Conclusion

Understanding health disparities and the data collected is key to producing not only added value to health, but trustable AI.

References

[1] Miller W, Wheeler E. Rural Profile of Arkansas, in: Social & Economic Trends Affecting Rural Arkansas, 2021.
[2] Wong DW, Li Y., Spreading of COVID-19: Density matters, PLoS One 15 (2020), e0242398.
[3] Kitchen C, Hatef E, Chang HY, Weiner JP, Kharrazi H. Assessing the association between area deprivation index on COVID-19 prevalence: a contrast between rural and urban US jurisdictions, AIMS Public Health 8 (2021), 519.