Racial disparities in access to health care infrastructure across US counties: A geographic information systems analysis

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Infrastructure system in the U.S. have been shown to be linked to social and
health inequities. We calculated driving distance to the closest health care
facility for a representative sample of the U.S. population using ArcGIS Network
Analyst and a national transportation dataset, and identified areas where Black
residents have a longer driving distance to the closest facility than White residents.
Our data demonstrated that racial disparities in access to health care facilities
presented large geographic variation. Counties with significant racial disparities
were concentrated in the Southeast and did not correspond to counties with
a greater proportion of the overall population >5 miles to the closest facility,
which were concentrated in the Midwest. This geographic variation demonstrates
the need to adopt a spatially explicit data driven approach in the design of
equitable health care facility establishment that address the specific limitations of
the local infrastructure.

KEYWORDS

racial disparities, GIS, health equity, health care infrastructure, health care access

Introduction

Infrastructure system in the U.S. have been shown to be linked to social and health
inequities (1, 2). This has been highlighted by the COVID-19 pandemic, which has
caused disproportionate health and economic harm to racial minority groups and socially
disadvantaged communities (3). The objective of this study was to calculate driving distance
to the closest health care facility for a representative sample of the U.S. population, and
identify areas where Black residents have a longer driving distance to the closest facility than
White residents.

Methods

We obtained the addresses of community pharmacies from the National Council for
Prescription Drug Programs, addresses of federally qualified health centers from the Health
Resources and Services Administration, and of rural health centers and hospital outpatient

FIGURE 1
Proportion of population with a driving distance to the closest facility ≥ 5 miles, by county. The map represents the proportion of population in each county with a driving distance >5 miles to the closest health care facility.

FIGURE 2
Counties with disparities in access to health care facilities. The map represents counties where Black residents had higher odds of having a driving distance >5 miles to the closest health care administration facility, compared to White residents. Red indicates counties where these disparities were significant at the $p < 0.05$ level.

departments from Centers for Medicare and Medicaid Services. The U.S. population was characterized with the 2010 U.S. Synthetic Population developed by RTI International (4).

For a 1% sample of the synthetic population (n = 2,982,544), we computed driving distance to the closest facility using ArcGIS Network Analyst and a national transportation dataset (5). For each county, we calculated the proportion of the population with >5 miles distance to the closest facility, and the odds ratio of having a distance >5 miles to the closest facility for Black compared to White residents.

Findings

The mean (median) number of health care facilities per county was 22 (7). In 889 counties, over 50% of the population had a driving distance >5 miles to the closest facility (Figure 1). These counties were concentrated in the Midwest.

Black residents were significantly more likely to live >5 miles to the closest facility than White residents in 56 counties (Figure 2). These counties accounted for a total population of 8.3 million and included 18 counties with more than 100,000 residents. The highest concentrations of these counties were in Mississippi (10 counties), Virginia (10), Louisiana (5), South Carolina (5), and Georgia (3). In 233 additional counties, Black residents had higher odds of living >5 miles to the closest facility than White residents, but the difference was not statistically significant. These counties accounted for a total population of 21 million.

Discussion

Racial disparities in access to health care facilities present large geographic variation. Counties with significant racial disparities were concentrated in the Southeast and did not correspond to counties with a greater proportion of the overall population >5 miles to the closest facility, which were concentrated in the Midwest. This geographic variation demonstrates the need to adopt a spatially explicit data driven approach in the design of equitable health care facility establishment that address the specific limitations of the local infrastructure.
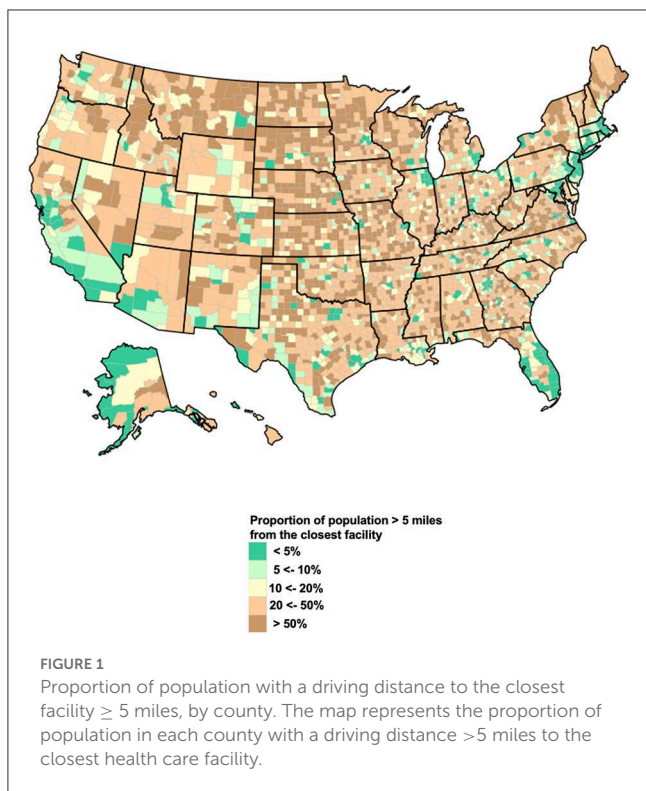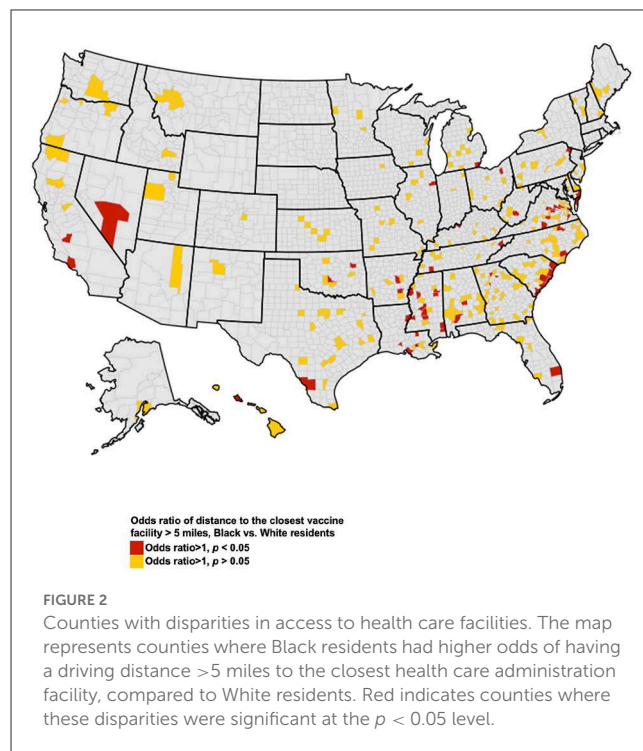
Individuals' socioeconomic status, such as income and education attainment, has been the focus of discussion around barriers to health care access and quality of care among racial and ethnic minority groups, including Black Americans (6). These discussions have often ignored how proximity to healthcare facilities present additional barriers to accessible care. Our geographic information system analysis can guide public health officials to identify areas that necessitate additional infrastructure as well as innovative community partnerships for equitable health infrastructure access. This is of utmost importance to prevent the historical disparities in access to healthcare from further magnifying disparities during public health crisis such as COVID-19 pandemic.

The strengths of the study include nationally representative samples, and the identification of geographic variation in racial disparities in spatial access to health care facilities. Nevertheless, our study is subject to limitations. Non-significant disparities are presented because our 1% sampling of the US population may have resulted in under-power to detect disparities among nonmetropolitan counties at the statistical significance level. Due

to lack of ethnicity data in the U.S. synthetic population, it was not possible to estimate access for Hispanic residents.

Our data demonstrates the structural inequities in access to the existing health care infrastructure across racial groups. These inequities should be addressed through the establishment of high-quality health care facilities in under-resourced communities, the expansion of public transportation, and improved community partnerships.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

JG: conceptualization, formal analysis, investigation, methodology, visualization, and writing—original draft. IH and LB: conceptualization, investigation, methodology, funding acquisition, supervision, resources, and writing—review and editing. SD, ST, and UE: investigation, methodology, writing—review, and editing.

All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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