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# Geospatial Health in the Context of Privilege and Cost: Determining Characteristic Based on Travel to Leisure and Protest Locations During COVID-19 Mitigation

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**Abstract**

Objectives: Determine community characteristics, within the context of the COVID-19 pandemic, based on travel to the popular leisure destination, Lake of the Ozarks in Missouri, and racial-justice protest locations in St. Louis, Missouri during key dates in May 2020.
Methods: Travel data was acquired from a U.S. marketing firm and consisted of anonymized and aggregated device GPS data. Sample inclusion was limited to residents of census-tracts within the City and County of St. Louis and St. Charles County, Missouri (n=384). Tract characteristics were obtained from the U.S. Census Bureau.
Results: Tracts with higher proportion of residents traveling to protest locations were significantly more likely to have higher proportion of: non-white residents, residents with no health insurance, and residents working in healthcare support and food service.
Conclusions: Based on characteristics, residents from tracts that had higher significant travel to protests are likely to be more adversely affected by the CoVID-19 pandemic. Further, significant differences in community characteristics highlight the racial inequities identified in CoVID-19 transmission
Policy Implications: Findings suggest it may be advantageous for local CoVID-19 mitigation efforts to adapt or collaborate with local racial-justice protesters.

JEL Codes: I14, I18
Keywords: Health Inequity; Socioeconomic Factors; Community-Acquired Infections; Spatio-Temporal Analysis

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**Introduction**

Most U.S. states have implemented mitigation polices to slow COVID-19 rates and reduce healthcare burden.[1] These policies utilize the concept of social distancing, a non-pharmaceutical intervention meant to interrupt infection through physical distance.[2, 3] However, rates of COVID-19 continue to increase, partially attributed to continued social event gathering.[4-8]

Recently, Missouri received national attention due to crowds gathering at the popular leisure destination of Lake of the Ozarks.[9] Concurrently, 200 miles away, crowds gathered in St. Louis, Missouri to participate in racial-justice protests.[10] These examples illustrate how communities assume additional risks related to COVID-19 but for varied contextual reasons. Examining these distinctive gatherings through the lens of community mobility, or patterns of geographic travel, is a common strategy employed in research.[11-13]

This study sought to determine differences in community-level characteristics based on travel patterns to leisure and protest locations within Missouri. We believe this will more effectively detail locations at risk for COVID-19 and clarify current epidemiological trends that reveal why racial minorities are up to five times more likely to acquire COVID-19.[14]

**Methods**

Anonymous mobility data was obtained from a COVID-19 Data Consortium managed by Safegraph LLC., consisting of observations from a national panel of over 45 million smart-phone GPS devices, and aggregated to the census-tract level .[15] Inclusion for this study included those residing within census-tracts located in the Missouri counties of St. Louis City and County and St. Charles County (n=384 census-tracts). Limiting inclusion to these counties was based on similar distance to locations of interest, similar COVID-19 burden, and proximity to one another.[16]

For each census-tract within the sample, the number of devices traveling to Lake of the Ozarks was calculated on each of the dates of interest; May 21, 2020 to May 25, 2020; coinciding with social gatherings reported.[9] Protest location travel per census-tract was determined by calculating the number of devices that traveled to one of fourteen census-tracts on May 30, 2020, considered to be a location of reported protests.[10] Since these fourteen census-tracts are contained within the 384 census-tract sample, residents of census-tracts where protests occurred were excluded from this count.

The 2018 5-year American Community Survey was used to compare differences in socio-demographics.[17] Variables were chosen based on a predicted influence on COVID-19 and included: proportion of residents aged ≥65, proportion of Black/African-American residents, proportion of residents with no health insurance, proportion of residents employed but earning wages below the federal poverty threshold, and proportion of residents working in healthcare support, and proportion working in food preparation or service.[18, 16]

Counts of travel to leisure and protest locations were smoothed over total devices per-census-tract using spatial empirical Bayes. Local spatial autocorrelation was implemented to identify significant clustering of census-tracts based on proportional travel to leisure and protest locations. Census-tracts determined to be core-clusters were stratified based on relationship between leisure and protest travel into one of two groups; (1) census-tracts having significantly higher travel to protest locations and lower travel to leisure locations or (2) having significantly higher travel to leisure locations and lower travel to protest locations. These two groups were then independently compared to all other census-tracts within the samples in a series of independent t-tests.

R 4.0 and GeoDa 1.1 software was used for all calculations and statistical analysis.[19, 20] Geospatial significance was reported using 999 permutations based on a calculated Moran's I value. Both geospatial and t-test significance were recorded at $\alpha = 0.05$.

**Results**

A total of 8,335 visits to leisure and protest locations were identified. Of these, 62.6% (n=5,218) were made to leisure locations and 37.4% (n=3,117) were made to protest locations. Local autocorrelation revealed 40 (10.4%) census-tracts were sources having high leisure-low protest location travel ($p<0.05$), while 61 (15.9%) were identified as sources of significant high protest-low leisure location travel ($p<0.05$). Comparative socio-demographics between these tracts are detailed in table 1.

Series one testing consisted of comparing 40 census-tracts, identified as having high leisure-low protest location travel, to all other census-tracts within the sample. These census-tracts were identified as having a significantly higher proportion of older adults, aged ≥65, (mean 17.4% vs 15.2%, $p=0.022$), lower proportion of African-American/Black residents (mean 3.4% vs 31.7%, $p<0.001$), lower proportion of residents with no health insurance (mean 4.1% vs 8.4%, $p<0.001$), lower proportion of residents employed but still living below the federal poverty level (mean 4.3%

vs 13.1%), lower proportion working in both healthcare support (mean 1.7% vs 3.9%, p<0.001), and food preparation and service (mean 3.4% vs. 6.5%, p<0.001).

Comparing the 61 census-tracts identified as having high protest-low leisure location travel to all other census-tracts determined, on average, these 61 census-tract had lower proportion of older adults (mean 14.3% vs 15.7%, p=0.036), higher proportion of African-American/Black residents (mean 69.6% vs 21.0%, p<0.001), higher proportion with no health insurance (mean 11.2% vs 7.4%, p<0.001), higher proportion of residents employed but still below the poverty level (mean 16.4% vs 11.4%, p=0.001), and higher proportion working in healthcare support (mean 7.5% vs 3.0%, p<0.001).

**Discussion**

This study identified sources of travel that have the potential to exacerbate risk COVID-19. Significant differences based on sources of travel were also identified. Residents of census-tracts with high protest-low leisure location travel shared many of the same characteristics already identified in COVID-19 disparities; higher proportion of African-Americans/Black residents, higher proportion uninsured, higher proportion likely to be "essential on-site employees, and higher proportion employed in poverty.[18, 21]

These same vulnerable characteristics were not associated among census-tracts with high proportion of travel to the leisure locations. Notably, these communities contained significant socio-demographic relationships that were converse to census-tracts identified as having high travel to protest locations. While the possibility of COVID-19 affecting any community remains high, there is evidence that these characteristics may be protective factors; possibly allowing for residents the confidence to travel for leisure.[22-24]

COVID-19 mitigation efforts are ongoing and have been specifically developed for multiple types institutions, environments, and event including: schools, businesses, restaurants, and parks, among others.[25-27] Our findings suggest a need to develop protest-specific COVID-19 mitigation practices. However, given the social importance and the critical need for racial-justice reform, any prevention efforts should support, not hinder, activism.

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All authors contributed equally to the development, design, and interpretation of this study.

Enbal Shacham, PhD was responsible for the initial text and subsequent drafts along with directing and administrating research activities.

Stephen Scroggins, MSc was responsible for data evaluation and analysis along with subsequent drafting of study text.

Matthew Ells, MPE was responsible for initial text and subsequent revisions.

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| Table 1. Characteristics based on significant travel patterns to social gathering locations[a] among Eastern Missouri census-tracts (n=384) | | | | | | |
|---|---|---|---|---|---|---|
| | Series 1 Comparison | | | Series 2 Comparison | | |
| | Census-tracts with high travel to leisure locations and low travel to protest locations (n=40) | All other census-tracts (n=344) | p-value | Census-tracts with low travel to leisure locations and high travel to protest locations (n=61) | All other census-tracts (n=323) | p-value |
| | % Mean (SD) | | | % Mean (SD) | | |
| Proportion residents aged ≥65 | 17.4 (6.2) | 15.2 (5.6) | 0.022[b] | 14.3 (4.3) | 15.7 (5.9) | 0.036[c] |
| Proportion African American/Black | 3.4 (3.9) | 31.7 (34.8) | <0.001[c] | 69.6 (24.1) | 21.0 (29.9) | <0.001[b] |
| Proportion with no health insurance | 4.1 (2.8) | 8.4 (5.9) | <0.001[c] | 11.2 (4.7) | 7.4 (5.9) | <0.001[b] |
| Proportion earning income but below poverty level | 4.3 (2.5) | 13.1 (10.9) | <0.001[c] | 16.4 (8.2) | 11.4 (10.9) | 0.001[b] |
| Proportion working in healthcare support | 1.7 (1.1) | 3.9 (4.5) | <0.001[c] | 7.5 (5.4) | 3.0 (3.7) | <0.001[c] |
| Proportion working in food preparation and service | 3.4 (2.0) | 6.5 (4.1) | <0.001[c] | 7.1 (4.1) | 6.1 (4.0) | 0.071[b] |

a. Sources of travel were identified on May 21, 2020 to May 25, 2020 for leisure travel and May 30, 2020 for protest travel
b. Determined using independent t-test at $\alpha = 0.05$
c. Determined using Welch t-test at $\alpha = 0.05$