Mapping Transit Deserts and Socioeconomic Vulnerability in Oklahoma City

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Keywords: GIS analysis; Oklahoma City; public transit accessibility; socioeconomic vulnerability; transit deserts; transportation equity

Introduction

Equitable access to public transportation is an important component of urban mobility and social opportunity because it affects residents' ability to reach employment, education, and essential services. The issue is especially important in large, low-density metropolitan areas where private vehicles are the dominant travel mode and transit service is concentrated in only part of the city. Oklahoma City has an extensive geographic footprint and a dispersed development pattern. EMBARK bus service is centered primarily in and around the urban core, while some peripheral and industrial areas have limited nearby service or practical pedestrian access. For residents who are unemployed, have low incomes, or live in households without a vehicle, this spatial mismatch can reinforce existing mobility disadvantages.

This study asks how access to public transportation varies across socially vulnerable neighborhoods in Oklahoma City and where the greatest equity gaps occur. Its objective is to identify transit deserts where limited walk access to bus stops overlaps with high socioeconomic need. The study contributes a transparent GIS workflow that integrates multiple vulnerability indicators, network-based walking access, thematic and combined hotspot maps, and a composite equity index at the census block-group scale. Rather than defining transportation disadvantage through a single demographic measure, the workflow evaluates several dimensions of vulnerability and clearly states the assumptions used to combine them.

Method

Socioeconomic data were obtained from the American Community Survey five-year estimates and analyzed at the census block-group scale. Three indicators associated with transportation disadvantage were selected: residents living below 150% of the federal poverty line, unemployed residents, and households without access to a personal vehicle. EMBARK bus-stop locations were obtained from General Transit Feed Specification data. Zoning information from the Oklahoma City Open Data Portal and TIGER/Line geographic boundaries provided additional land-use and spatial context.

All datasets were processed in ArcGIS Pro. A 1,000-meter (0.62-mile) network-based walk-access area was generated around each bus stop using the street network. The threshold approximates a reasonable pedestrian distance to public transit while accounting for network connectivity rather than only straight-line distance. The walk-access areas were intersected with census block groups, and geometry calculations

estimated the proportion of each block group located inside and outside accessible distance of a bus stop. Because population and socioeconomic totals are reported for complete block groups, accessible population was estimated under an assumption of uniform distribution within each block group. Geometry tools and Python field calculations were used to compute area percentages, standardize values, and address data inconsistencies.

Separate maps displayed zoning, poverty, unemployment, and households without vehicles in relation to transit access. Combined maps then overlaid pairs of vulnerability indicators with the walk-access areas to identify locations where multiple disadvantages occurred together. For the final synthesis, the three socioeconomic indicators and the transit-access deficit were normalized to a common 0-1 scale, with higher values representing greater need. The normalized measures were averaged using equal weights to create a multidimensional equity index. Equal weighting preserved a clear and reproducible interpretation without assigning unsupported priority to any single indicator.

Results

The analysis reveals substantial citywide gaps in walk access to public transportation. Only 37% of Oklahoma City's population lives within 1,000 meters of a bus stop, while 63% lives outside the walkable threshold. This pattern reflects the city's automobile-oriented form and the concentration of bus service within the developed core.

Accessibility varies across the three vulnerable groups. Among residents living below 150% of the federal poverty line, 58% are located inside the walk-access area and 42% are outside. Households without a vehicle show the strongest relative proximity to transit: 61% are within the walk-access area and 39% are beyond it. These groups are more concentrated near the urban core, where bus-stop coverage is denser. Nevertheless, the shares outside the service area remain substantial because people without reliable private transportation may be especially affected by access gaps. Unemployed residents experience weaker access: only 42% are within 1,000 meters of a bus stop, while 58% are outside, indicating a potential spatial barrier to employment opportunities and workforce services.

The maps show that poverty, unemployment, and households without vehicles cluster in several central and southern neighborhoods, yet many high-need areas remain outside walkable access to bus stops. The combined maps reveal locations where poverty and unemployment, or poverty and lack of a vehicle, overlap with weak transit access. The composite equity index consolidates these patterns into a single map and identifies block groups where socioeconomic vulnerability and limited transit access coincide most strongly. These locations represent priority areas for closer evaluation of service expansion, route adjustment, or improved walking connections to existing stops.

Discussion and Conclusion

The findings show both partial alignment and significant mismatch between Oklahoma City's transit network and socially vulnerable populations. A majority of residents below 150% of the poverty line and households without vehicles are within the walk-access threshold, but 42% and 39%, respectively, remain outside it. In addition, most of the city's total population and unemployed population is beyond walkable access. Evaluating only

the concentration of transit-dependent residents near the urban core would therefore understate the broader geographic extent of transportation disadvantage.

The workflow's principal value is transparency. The individual maps and composite index show how each indicator contributes to the final priority pattern rather than relying on an opaque score. The results can support preliminary screening for route modifications, additional stops, improved walking connections, or more detailed community-based study. The approach is also transferable to other car-dependent metropolitan regions with comparable census and transit data.

The analysis assumes uniform population distribution within block groups, assigns equal importance to all indicators, and represents accessibility through a fixed walk-distance threshold. It does not directly measure transit frequency, operating hours, reliability, travel time to destinations, service quality, or detailed pedestrian conditions such as sidewalks and crossings. Future work should incorporate these measures, test alternative weights and thresholds, and include community feedback. Despite these limitations, the study demonstrates how an interpretable GIS-based equity assessment can reveal where transit access and socioeconomic need are most poorly aligned and provide a defensible basis for prioritizing more equitable public transportation investment.