Livability and Service Access for Student Renters in Washington, D.C.

Siddha Khatal

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Abstract

Students in Washington, D.C. face a tradeoff between rent and access to essential services. Affordable apartments often sit far from grocery stores, transit, and hospitals. This paper measures how livability varies across the city using a composite index based on four indicators from the DC Open Data Portal. Census tracts serve as the spatial unit. Grocery access, metro access, hospital access, and the share of affordable housing are standardized to percentile values for equal weighting. The indicators are averaged to form a livability score. The map uses Natural Breaks to show clusters. A spatial join counts medical facilities inside each tract to show hospital accessibility. Central and northwest tracts show high livability. Eastern tracts show low scores. The maps show a divide that shapes convenience and vulnerability for student renters. Improving service access in underserved areas can support more equitable livability across the district.

1 Introduction

Rent levels in Washington, D.C. pose a challenge for students seeking housing. Studio apartments in the northwest core cost between $2,300 and $2,500 per month. Cheaper units in the $1,400 to $1,700 range tend to be far from daily amenities. Students trade travel time for affordability. Livability depends on access to food, transit, and healthcare. This study identifies neighborhoods that balance cost and essential access. The goal is to find places where living is easiest. This index compares census tracts across the city. It emphasizes accessibility. A second map shows hospital locations to highlight medical access. The results offer a tool to assess suitability for student renters. The findings show where infrastructure supports daily needs and where it falls short.

2 Literature Review

Livability relates to access to essential services. Built environments that support daily needs improve well being. Vlahov and Galea (2002) show that urban health depends on proximity to services and transportation. Pacione (1990) links quality of life to nearby amenities. These studies show livability as a spatial condition. Healthcare access is a key dimension. Wang and Luo (2005) show that proximity to medical facilities improves response time. Transit dependent groups face greater risk when hospitals are distant. Luo and Qi (2009) count nearby access opportunities through spatial aggregation. Their method supports tract level Join_Count analysis. Researchers build livability indices to expose access gaps. Bhat and Gossen (2004) map transit, food, and recreation to measure desirability. Brookings Institution (2011) applies accessibility weighted indicators to show structural inequity. GIS studies use choropleth maps to reveal spatial inequality. Natural Breaks identifies clusters. This project applies the same logic. It maps a multi indicator index and hospital presence in Washington, D.C. The focus is on access that supports daily living. The study uses spatial joins, tract aggregation, and cluster classification.

3 Data

The analysis uses datasets from the DC Open Data Portal. Census tracts serve as the unit of analysis. The study combines built environment indicators with tract boundaries to evaluate livability and medical access. Four variables shape daily living. Grocery access measures food availability. Metro access measures transit reach. Affordable housing share indicates lower cost units. Hospital count tracks medical presence. These reflect student needs. A census tract shapefile provides geometry. Attribute tables are joined to polygons. The data represent current conditions. No time adjustments are applied. Each variable supports spatial aggregation and cross location comparison. Open sources ensure reproducibility and alignment with official infrastructure records.

4 Methods

The study evaluates livability and hospital accessibility at the tract level. Two spatial procedures produce the outputs.

4.1 Indicator Standardization

Raw values differ in scale. Each variable is converted to percentile values. Equal weighting reflects the equal importance of each service. This keeps the index balanced.

4.2 Livability Index Construction

The index equals the average of the four percentile indicators.

$$\text{Livability Index} = \frac{\text{Grocery Access} + \text{Transit Access} + \text{Hospital Access} + \text{Affordable Housing Share}}{4}$$

Scores cluster in central and northwest neighborhoods. Low scores appear in southeast and northeast tracts. Natural Breaks with five classes highlights disparities.

4.3 Hospital Accessibility Mapping

Hospital access is mapped separately. A spatial join counts facilities inside each tract. The Join_Count field shows direct medical presence. Graduated symbols show variation. High access appears in Foggy Bottom, Shaw, Logan Circle, and Columbia Heights. Low access appears in Anacostia, Congress Heights, and Deanwood.

4.4 Spatial Clustering Test

Moran's I tests clustering in Join_Count values. Contiguity defines tract neighbors. A positive and significant result indicates real clustering. The test confirms that access patterns are not random.

4.5 Mapping Outputs

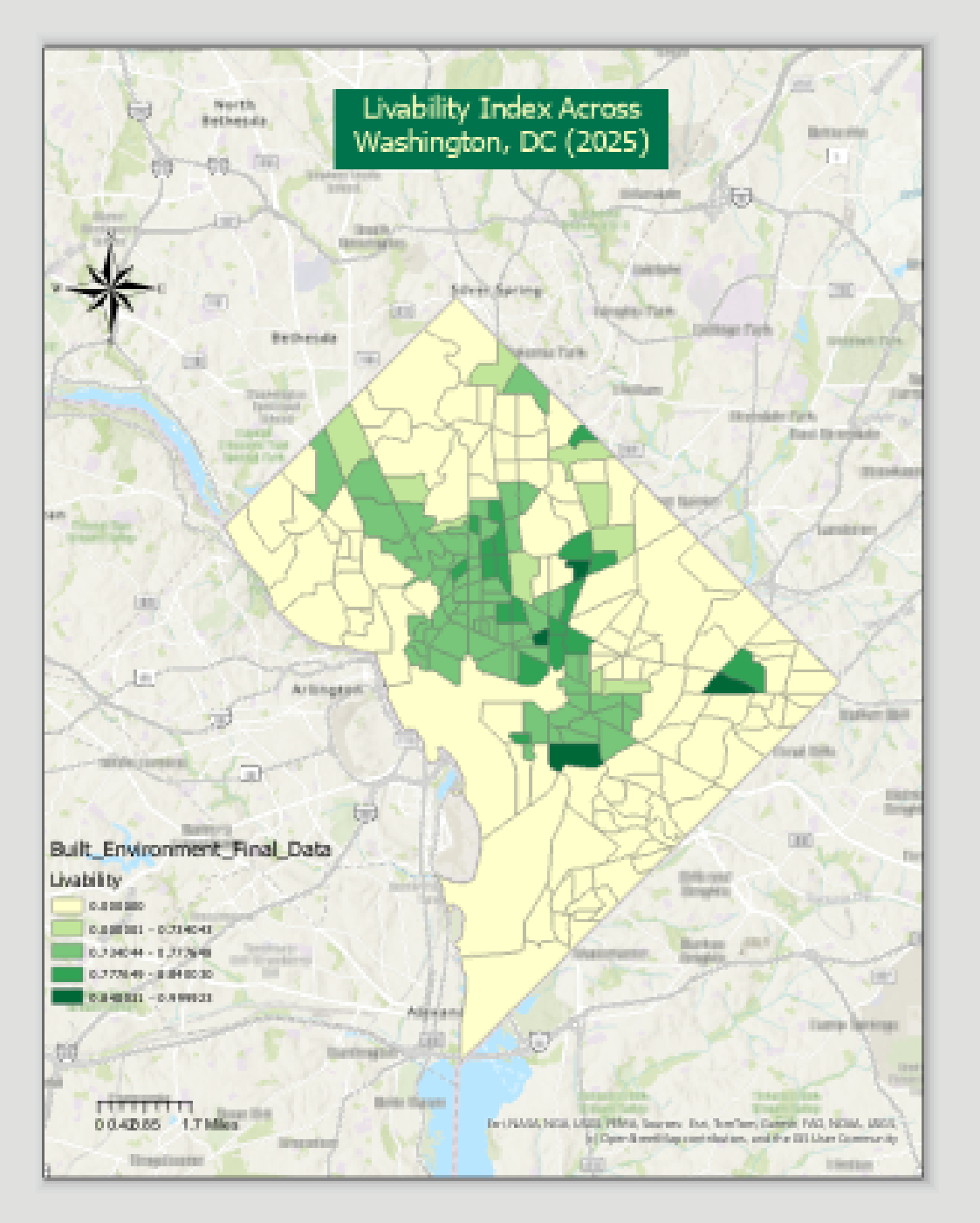

Figure 1: Livability index across Washington, D.C.

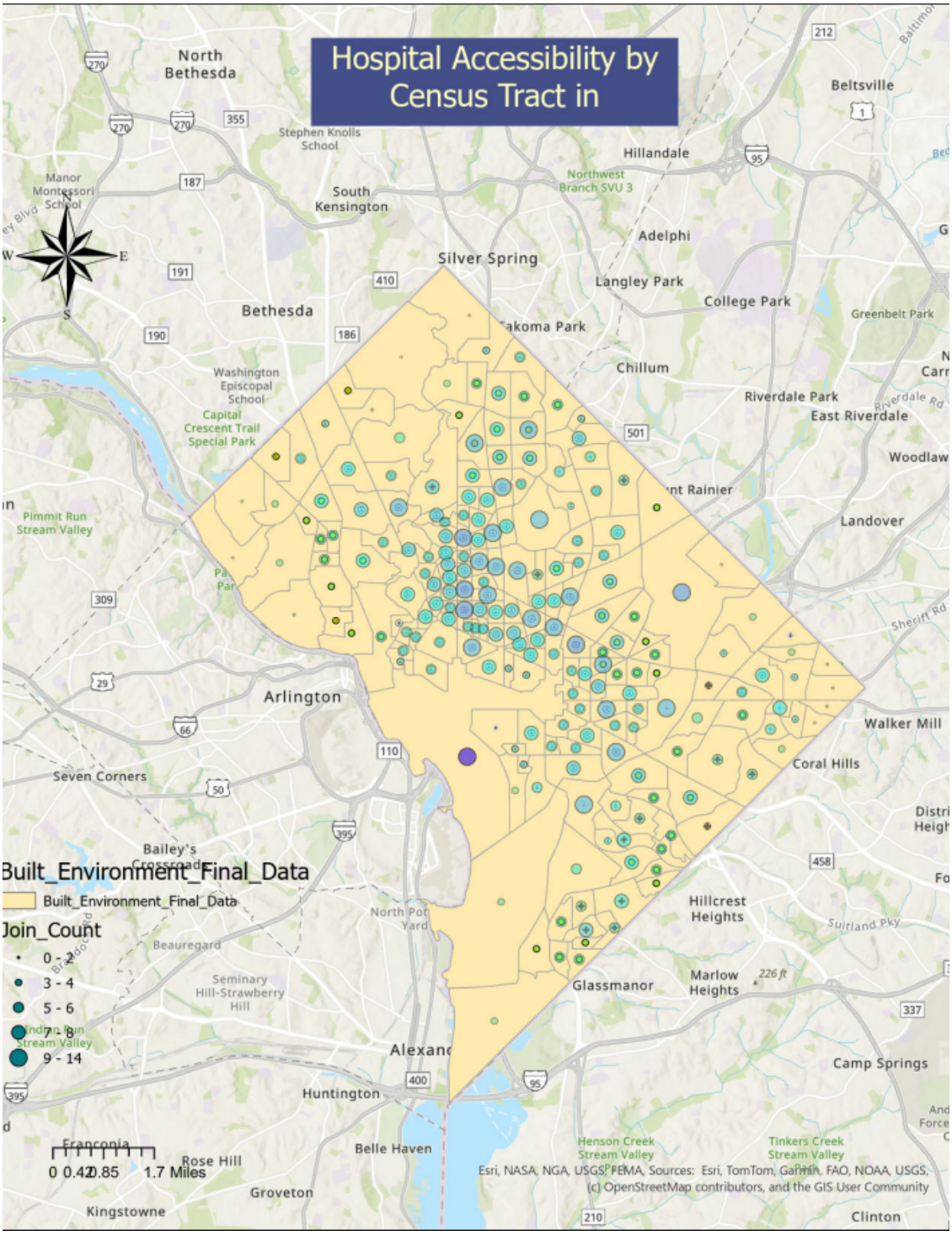

Figure 2: Hospital accessibility by census tract

5 Results and Interpretation

The livability index shows a clear divide. Dupont Circle, Columbia Heights, and Logan Circle show high livability. They offer nearby food, transit, and care. They also include affordable housing. Daily needs require less travel. Low scores appear in Anacostia, Congress Heights, and Marshall Heights. Trips for essential services take more time. They do not support daily living as well as the center and northwest. Hospital accessibility shows the same pattern. Foggy Bottom, Shaw, Logan Circle, and Columbia Heights contain the most facilities. Care is close. Eastern tracts often have none. Risk rises when medical access is distant. Moran's I equals 0.633. The z score equals 24.93. The p value equals 0.000. Clustering is strong. Central and northwest tracts group together. Eastern tracts group together. The divide is not random. Essential services concentrate in one part of the city. Students in lower rent areas trade cost for convenience and safety. The results show a structural divide in the built environment.

6 Conclusion

The study asks where students can live with reliable access to essential services. Central and northwest tracts provide the strongest support. Southeast and northeast tracts provide fewer services. Hospital presence shows the same shortage. Spatial testing confirms the cluster pattern. Accessibility shapes daily convenience. Washington, D.C. delivers that access unevenly.

7 Limitations

The analysis measures access. It does not measure service quality. Hospital count does not show capacity. Grocery access does not show selection. The study uses one time period. Price variation within tracts is not measured. These limits do not alter the core finding. Central and northwest neighborhoods remain advantaged. Eastern tracts remain underserved.

8 References

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