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Associations between gentrification, greenspaces, and obesity prevalence:

A case study of the Atlanta Metropolitan Area

By

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Degree to be awarded: Master of Public Health

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B.S., Biology, Emory University, 2022

Thesis Committee Chair: Dr. Joellen M. Schildkraut PhD, MPH

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Abstract

Associations between gentrification, greenspaces, and obesity prevalence:

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This study investigates the complex interactions between gentrification, greenspace, and obesity prevalence in the Atlanta Metropolitan Area, focusing on three primary objectives: to analyze the methodological and contextual factors defining gentrification using three different indices; to assess the impact of greenspace changes on urban areas based on gentrification status; and to examine the association between neighborhood gentrification, walkability, greenspace changes, and obesity prevalence. Data for this analysis were sourced from public databases including the U.S. Census, the American Community Survey, the National Landcover Database, and the CDC Places Database. Gentrification was classified using three established indices—Sutton, Freeman, and Ding—which utilize socioeconomic, demographic, and housing data to segment the metropolitan area into gentrifying, eligible but did not gentrify, and nongentrifiable designations.

These findings indicate significant differences between the indices in identifying gentrifying areas, underscoring the contextual sensitivity of gentrification metrics. While overall changes in canopy cover were minimal, detailed analysis revealed significant disparities in baseline greenspace levels across different neighborhoods, with wealthier, nongentrifiable areas exhibiting the highest greenspace coverage and lowest obesity rates. This suggests that pre-existing conditions significantly influence both the physical and health disparities of communities. Moreover, the study highlights that increased walkability and greenspace are associated with reduced obesity prevalence, emphasizing the importance of these factors in urban planning. However, the benefits varied significantly with gentrification status. In gentrifying areas, despite potential increases in greenspace and infrastructure, obesity prevalence was the highest among all categories. These results advocate for a more nuanced approach to redevelopment that integrates public health considerations, ensuring equitable access to health-promoting amenities. Future policies should focus on creating inclusive, sustainable environments that support the well-being of all urban residents, particularly for those in transitioning neighborhoods.

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Introduction

Gentrification, the multifaceted process of urban revitalization characterized by demographic shifts, economic changes, and structural transformations, reshapes landscapes and lives across the United States (Schnake-Mahl et al., 2020). Commonly, gentrification is thought of as a process of neighborhood change in which higher-income households move into a low-income neighborhood, resulting in increased housing prices, changes in the racial and ethnic composition of the neighborhood, and the displacement of lower-income residents. The process has been associated with improvements in greenspaces like public parks, mediation of disparities related to environmental pollution exposure, and protective for depression/anxiety among residents (Servadio et al., 2019; Triguero-Mas et al., 2022; Zayas-Costa et al., 2021). However, the onset of gentrification also raises concerns about displacement, dispossession, and its potential impacts on population health (Lim et al., 2017; Smith et al., 2020).

In 1964, sociologist Ruth Glass first coined the term in her publication "Aspects of Change", in which she described the displacement of the poor in London as upper-class people moved in to refurbish houses in previously working-class areas (University of London. Centre for Urban & Glass, 1964). Over the last 60 years, scholars have addressed the need to understand the nuance and change associated with gentrification in changing contexts and locations. Daniel Hammel and Elvin Wyly expand on the idea in 1996 by providing a framework for identifying gentrifying areas using United States census data (Hammel & Wyly, 1996-4-1). They defined gentrification as the replacement of low income, central-city working-class residents by an influx of middle- or upper-class households, through either the current housing market or new upscale housing construction. Their model was 90% accurate as distinguishing between areas of heavy reinvestment and stable middle-class neighborhoods within 24 census tracts in Minneapolis-St.

Paul, Minnesota. Since then, several researchers have proposed further comprehensive definitions of gentrification, based on case studies from various cities in the U.S. in order to understand the effects of demographic transformation on local economies and population mobility. More recently, gentrification has been brought in relation to several public health concerns (Hirsch & Schinasi, 2019) .

Alongside the rise in the recognition of the role the social determinates of heath have on health disparities, gentrification has greatly expanded. Numerous demographic, socioeconomic, and housing-related variables were used to create an index of gentrification at the neighborhood-level. These indices rely on readily accessible, and primarily publicly collected data, capturing changes in demographic composition, real housing prices, and the length of time a resident has lived in the area (Ding et al., 2016; Freeman, 2005; Sutton, 2018).

As cities undergo significant demographic and economic shifts, the impacts of gentrification extend beyond housing markets and social dynamics, influencing various aspects of urban life, including access to green spaces, recreational sites, or healthy food stores (Alkon & Cadji, 2020; Jeong & Liu, 2020; Mears et al., 2019). Therefore, each aspect of how gentrification influences the character of a community can be studied and identified, such as “green gentrification” (Jelks et al., 2021). Green gentrification refers to the increase or beatification of neighborhood green spaces as a result of underlying population shifts. Increases in green space can increase the opportunities for physical activity and have been associated with a lower risk of cardiovascular disease events (Geneshka et al., 2021).

Atlanta, Georgia provides an ideal setting for studying gentrification due to its dynamic urban environments and historical legacies of racial segregation. The city has undergone

contemporary demographic shifts and reinvestment over the last 20 years which provides a particularly compelling context for studying the classification of gentrification.

As of 2022, the city is home almost half a million residents and has experienced an increase in almost a hundred thousand over the last 10 years (Research, 2023). The median home price in metro area was $350,000 with the median resident annual household income at $73,000, indicating the challenge for homeownership for many in the area. Many central city neighborhoods in Atlanta have experienced significant reinvestment since the turn of the century, underlined by large infrastructure projects including the Ponce City Market and the Beltline (Brasch & Capelouto, 2022). From the revitalization of areas like Old Fourth Ward and West End to the ongoing debates surrounding housing affordability and displacement, Atlanta encapsulates many facets that exemplify the gentrification process in action.

As epidemiological researchers continue to study the impact of social determinants of health, it is necessary to examine both the ways in which processes such as gentrification are defined and how a given definition may affect its association with the health of neighborhoods and the individuals residing within them. By employing a comparative analysis of multiple gentrification indices, investigating spatial patterns, and conducting a statistical analysis, this study has three specific aims: 1) it seeks to investigate the complexity of contextual and methodological factors defining gentrification in Atlanta metropolitan area; 2) to evaluate differences in greenspaces across Atlanta metropolitan area, considering their gentrification status; and 3) estimate where there is an association between neighborhood gentrification status, walkability, change in greenspaces over time and obesity prevalence.

Methods

Aim 1: Investigate the complexity of contextual and methodological factors defining gentrification in Atlanta metropolitan area.

Data for this analysis were derived from multiple publicly available sources. Variables used for the gentrification index calculations were obtained from Social Explorer; An opensource repository for the United States Decennial Census (Census), American Community Survey (ACS) five-year estimates, and many other databases. The 2010 Census and the ACS 2014-2018 five-year estimate were used as the baseline and end years for the extraction of socioeconomic, demographic, and housing variables for gentrification index creation. Both the Census and ACS five-year estimates provide representative data on the United States population at the census tract level (e.g., neighborhoods of approximately 4,000 residents).

Three publications were selected to serve as guidelines when creating the gentrification indices. These papers by Stacy Sutton (Sutton, 2018), Lance Freeman (Freeman, 2005), and Lei Ding (Ding et al., 2016), who are all well published in their fields of sociology, epidemiology, and city planning, showcase well contextualized interpretations for how to define the process of gentrification using readily available information. Each author provides a nuanced interpretation of how to measure gentrification at the census tract level using socioeconomic, demographic, and housing information. To make these three indices directly comparable, the methodology of each index was adopted to the study period 2010-2018 and organized into three categories: nongentrifiable/ineligible to gentrify, eligible but did not gentrify, and gentrifying.

The first index constructed was defined by Sutton 2020. Here, gentrification is conceptualized as a unit weighted composite score from the sum of percentage point differences between a multi-annual period. The index requires data from the Census and ACS 5-year

estimates on home ownership, the year residents moved into their property, the percentage of residents with a college degree or greater, and the population of residents 25 years and older. The composite score was computed using the difference between the share of college-educated residents, the share of neighborhood newcomers, and the share of owner-occupied housing units between 2010 and 2018. Additionally, tracts could not be eligible for gentrification if they were upper income in the previous time period. Upper-income areas were defined as having a household income at least 40% greater than the metro average. Tracts were classified as gentrifying if they obtained index scores one standard deviation above the metro average during the defined period and were not upper-income areas previously. This structure creates a three-tiered index where tracts can be classified as: *nongentrifiable* (1), *eligible but did not gentrify* (2), and *gentrifying* (3).

The second index used was conceptualized by Lance Freeman in his 2005 paper on gentrification and displacement. The index requires Census and ACS 5-year estimates of median household income, number of housing units, percent of residents with a bachelor's degree or higher, median home value, and median gross rent. The index constructed utilized 3 criteria for identifying neighborhoods as eligible to gentrify, and two criteria for defining those eligible as gentrifying. The first three criteria require a neighborhood to: a) be located in the metro area, b) have a median income less than the 40th percentile for the metro area at the beginning of the period, c) and have a proportion of housing built within the past 20 years lower than the 40th percentile of the metro area. The final two criteria identify neighborhoods that: d) undergo a percentage increase in educational attainment greater than the median increase in educational attainment for the metro area and f) experience an increase in real housing prices during the period. Census tracts were labeled *nongentrifiable* (1) if they did not meet all three initial

criteria, *eligible but did not gentrify* (2) if they met the first three criteria but not the last two, and *gentrifying* (3) if they experienced all five criteria requirements.

The third index was sourced from Ding 2016, where gentrification was conceptualized as a financial upgrading of previously low-income, central-city neighborhoods, characterized by an influx of higher socioeconomic status residents and an increase in housing prices. It utilizes Census and ACS 5-year estimate data on median family income, percent of residents with a college degree or higher, median gross rent, and median home value. First, if census tracts had a median income less than the metro median income at the beginning of the period they are identified as *gentrifiable* and if not, they are considered *nongentrifiable* (1). Next, *gentrifiable* neighborhoods were further classified as *gentrifying* (3) if they experienced an increase in the gross median rent or home value greater than that of the metro area and an increase greater than the metro median in the percentage of college-educated residents. Tracts that did not meet those criteria, but were *gentrifiable* at the beginning of the period, were classified as *eligible but did not gentrify* (2).

To understand each indices comparability, a sensitivity analysis was applied to estimate the agreement rates between the three indices for each gentrification category for the 951 census tracts that constitute the Atlanta-Sandy Springs-Roswell area (Atlanta Metro). Additionally, descriptive summaries for the underlying gentrification index variables were computed for every gentrification category across all indices in order evaluate the socio-economic characteristics and changes over time.

Aim 2: Evaluate differences in greenspaces across Atlanta metropolitan area, considering their gentrification status.

The measure of greenspace is defined as percent canopy cover in 2011 and 2018. Canopy data was not available for 2010 (Housman et al., 2023). Percent canopy cover was chosen over the more commonly used normalized difference vegetation index (NDVI) as NDVI is sensitive is large changes in weather such as drought or heavy seasonal rains. Canopy data are derived from the National Landcover Database, a U.S. Geological Survey operated platform. Original canopy data is derived from satellite remote sensing imagery, available for the entire U.S. at 30meter spatial resolution. Each pixel represents the percent canopy of that area. To adopt these data into the analysis, an average percent canopy cover was estimated for each census tract in the study area for 2011 and 2018. Then, a percent-point difference between them was calculated. The conversion and extraction of raster values was performed suing R package terra.

Based on this analysis of the three indices (Aim 1), only one index, which produced the most robust and clear interpterion for gentrification within the Atlanta metro area compared to the other indices was selected for further analysis. The Sutton index demonstrated the most accurate depiction of gentrification when looking at the underlying index values as well as produced a spatial distribution of gentrification classification which appeared nonrandom. This index was then used as the exposure for non-spatial linear and spatial Bayesian regression models to understand the associations between changes in tract-level greenspaces/canopy over time. Analysis was performed at the metropolitan area level and at the city level only. All models were implemented using a non-spatial linear regression and a spatial linear regression, available in the R BayesX package (Belitz et al., 2015). The BayesX package incorporates spatial

correlation structures into the regression models allowing for an estimation of the relationships between variables accounting for possible spatial autocorrelation dependencies.

Aim 3. Estimate where there is an association between neighborhood gentrification status, walkability, change in greenspaces over time and obesity prevalence.

Prevalence data on obesity at the census tract level for 2021 was derived from the CDC's Places database (CDC, 2023b). The national walkability index was obtained from the U.S. Environmental Protection Agency (EPA) for 2021. This index is a U.S.-wide product that defined a score 0-100 for all block groups based on their relative walkability, considering availability and connectivity of pedestrian sidewalks. To adopt this index, block groups were summarized based on their membership in a census tract and an average tract-level walkability score was estimated. All tracts were then ranked into 4 categories ("Least walkable", "Below average walkable", Above average walkable", "Most walkable") following the EPA methodology (CDC, 2023a).

In the statistical analysis, first, an unadjusted linear regression was used to estimate the association between walkability, proportion of and changes in the tree canopy cover, income-level, and gentrification with obesity prevalence. Then, the association between walkability, changes in the tree canopy cover and obesity prevalence was examined in an income-adjusted model when stratified by the gentrification status at the levels of the metropolitan area and the city area only.

Results

Aim 1: Investigate the complexity of contextual and methodological factors defining gentrification in Atlanta metropolitan area.

Sutton Gentrification Index

Using the Sutton Index, out of the 951 census tracts in the Atlanta-Sandy Springs Metro Area, 126 (14%) census tracts were classified as *nongentrifiable*, 695 (73%) were *eligible, but did not gentrify*, and 123 (13%) tracts were identified as *gentrifying*. Seven census tracts were unable to be classified due to missing demographic data.

Evaluating the socio-demographic characteristics of tracts with different gentrification status, *nongentrifiable* tracts have the highest average median income of $124,278.87 in 2010 and $121,196.79 in 2018 compared to other tracts (Table 1). *Nongentrifiable* tracts also experienced a high level of home ownership (88% in 2010 and 84% in 2018) and share of persons with a college education or higher (39% in 2010 and 38% in 2018). The percentage of those who moved there in the last 10 years substantially decreased over time (57% in 2010 and 15% in 2018).

Tracts that were *eligible but did not gentrify* had an average median income of $63,221.74 in 2010 and $61,571.60 in 2018 (Table 1). These neighborhoods saw no change in the share of college educated residents (19% in 2010 and 20% in 2018) and homeownership levels (64% in 2010 and 59% in 2018). Additionally, eligible tracts experienced a decrease in the share of residents who move there in the last 10 years (67% in 2010 and 20% in 2018).

Gentrifying tracts in 2010 had an average median income of $56,317, which increased to $62,364.74 in 2018 (Table 1). These neighborhoods also experienced a slight increase in the share of residents with a college degree or higher (21% in 2010 and 23% in 2018), a slight

decrease in the share of homeowners (57% in 2010 and 55% in 2018) and decrease in share of residents who moved there in the last 10 years (70% in 2010 and 22% in 2018).

Freeman Gentrification Index:

Under the Freeman definition of gentrification, of the 951 census tracts, 550 (33%) were *nongentrifiable*, 389 (41%) were *eligible, but did not gentrify*, and 7 (1%) were considered *gentrifying*. Five census tracts were missing underlying data for the index and could not be classified.

Nongentrifiable census tracts had an average median income of $88,507.63 in 2010 and $ $89,380.06 in 2018. As of 2010, 51% of housing units were built in the past 20 years while in 2018 these were 30% (Table 2). Home values and rents also remained high among these tracts both in 2010 and 2018. Census tracts that were *eligible but did not gentrify* had an average median income of $45,636.38 in 2010 and $42,378.10 in 2018. These areas saw a slight increase in the percent of residents with at least a college degree (13% in 2010 and 15% in 2018) and a decrease in home value and rent across the period. The *gentrifying* neighborhoods were observed to have an average median income of $41,754.29 in 2010, which increased to $45,646.43 in 2018. These tracts also underwent an increase in the percent of the population that had a college degree or higher (15% in 2010 and 22% in 2018). Home values and rents increased during the time period within these census tracts from $196,689.00 and $1,018.14 in 2010 to $45,646.43 and $226,328.57 in 2018 respectively.

Ding Gentrification Index:

Based on the definition developed by Ding, of the 951 census tracts in the Atlanta metro area 473 (50%) were classified as *nongentrifiable*, 156 (16%) as *eligible, but did not gentrify*, and 315 (33%) as *gentrifying*. Seven census tracts were not able to be classified because of

missing demographic data. This index identified the greatest number of tracts as gentrifying within the metro area compared to the other two indices.

Nongentrifiable neighborhoods had an average median household income of $94,407.98 in 2010 and $91,977.55 in 2018 (highest compared to all other categories) (Table 3). These tracts also experienced consistent high percentages of college educated residents (29% in 2010 and 30% in 2018) and housing prices across the period. Among eligible tracts, those that were classified as *gentrifying* experienced an increase in the percent of residents with a college degree, home values, and rents. Census tracts that were classified as *eligible but did not gentrify* had an average median household income of $45,903.60 in 2010 and $51,121.12 in 2018. The percent of residents with a college degree also increased in these areas (16% in 2010 and 21% in 2018) as did home values and rents. *Gentrifying* areas under this index were paradoxically categorized. These areas, on average, did not experience an increase in the percent of college educated residents (15% in 2010 and 14% in 2018) and underwent a decrease in home values and rent.

Comparing Gentrification Indices

As each definition of gentrification had different underlying criteria, agreement rates were mixed between the indices depending on the tract's gentrification status. When comparing the Sutton and Freeman indices, there was low agreement on the census tracts that reached *gentrifying* status. The Sutton index agreed with 14% of the tracts identified by Freeman as *gentrifying* and the remaining tracts were identified as eligible (Table 4). The two indices had greater agreement for areas *eligible but did not gentrify* with 83% of tracts identified under Freeman matching with Sutton. The remaining eligible tracts were identified as *gentrifying* or *missing* under Sutton. For *nongentrifiable* census tracts, the Sutton index meet agreement with

23% of the tracts identified by Freeman. Over 65% of the areas considered *nongentrifiable* by Freeman were considered *eligible* with 10% reaching *gentrifying.* However, while the Freeman index identified many more areas as *nongentrifiable*, the indices agreed on 100% of the *nongentrifiable* census tracts identified by the Sutton index (Table 4).

Between the Sutton and Ding indices, the Sutton index agreed with 12% of the *gentrifying* areas identified while the remaining 88% were classified as *eligible but did not gentrify* (Table 5). When classifying areas as *eligible, but did not gentrify*, the two indices were more aligned. The Sutton index met agreement with 70% of the tracts Ding identified as *eligible but did not gentrify*. The other 30% of Ding eligible tracts were considered *gentrifying* under Sutton. For the *nongentrifiable* Ding census tracts, the Sutton index met agreement with 27% of tracts while the other 64% were considered *eligible but did not gentrify* and 8% *gentrifying*.

Between the Freeman and Ding indices, there was high levels of agreement between among the *nongentrifiable* and *eligible but did not gentrify* census tracts but low agreement on *gentrifying* census tracts. As this comparison is between the most liberal and restrictive indices in classifying *gentrifying* areas, the Freeman index met agreement with less than one percent of tracts identified by Ding (Table 6). Conversely, 30% of the tracts identified by Freeman met agreement with Ding while the other tracts were classified as *eligible but did not gentrify.* Among tracts that were *eligible, but did not gentrify,* the Freeman index agreed with 60% of the tracts identified by the Ding Index. However, 68% of *eligible, but did not gentrify* tracts identified by Freeman were considered gentrifying by the Ding index (Table 6). Within the *nongentrifiable* census tracts, the Freeman index met agreement with 94% of the tracts identified by the Ding Index. Moreover, 81% of the Freeman *nongentrifiable* tracts were also contained within the Ding index.

Mapping the results from each index unveiled a strong geographic variation in the spatial distribution of tracts' gentrification status between all three indices. According to the Sutton index, nongentrifiable tracts were predominantly found in the north of Atlanta. In contrast based on the Freeman and Ding indices, the area of nongentrifiable tracts was substantially larger, covering most parts of the suburban areas around the City of Atlanta. The Sutton index classification of areas *eligible but did not gentrify* increases moving out of the central city (Figure 1). *Gentrifying* tracts among this index demonstrates spatial clustering near the center of the city and around *nongentrifiable* areas. Additionally, there are areas of *gentrifying* neighborhoods further away from the center city in counties that predominantly *eligible but did not gentrify*.

Under the Freeman gentrification index, *nongentrifiable* and *eligible, but did not gentrify* neighborhoods exhibit a North-South divide, with the majority of *nongentrifiable* areas identified in the north and *eligible but did not gentrify* in the south of the metro area (Figure 2). However, there are large clusters of *nongentrifiable* areas found in the southern counties of the Atlanta metro area. Under this definition of gentrification, the few *gentrifying* census tracts that were identified were mainly found bordering the Atlanta city area near the center of the map.

Unlike the Sutton and Freeman indices, where *gentrifying* areas were found around the center of the metro area, the Ding gentrification index observed the largest spread of areas identified as *gentrifying* across the metro area (Figure 3). *Gentrifying* areas under this conceptualization were found at the outmost edges of the metro area and within the city boundaries. *Eligible, but did not gentrify* census tracts were the least observed classification under this index and were scattered around the city boarders and metro area edges.

Nongentrifiable neighborhoods were identified to be in-between the central city and western/eastern *gentrifiable* areas.

Aim 2: Evaluate differences in greenspaces across Atlanta metropolitan area, considering their gentrification status.

Selecting an Index for Canopy Change Analysis

Based on the index variable classification analysis above, the Sutton gentrification index was selected to be used to compare how percent canopy coverage changes over the predefined period. This index met the expectations for what we should expect when identifying gentrification among metro areas. *Nongentrifiable* areas were of high median household incomes and saw a constant share of college education residents during the period. Additionally, this index identified areas as *gentrifying* which underwent increases in the median household incomes and share of college educated residents.

In the selection process for an index to analyze canopy change, the Freeman and Ding indices did not accurately classify tracts based on their own gentrification criteria. Specifically, the Freeman Index, which should identify gentrifying areas with increases in property values and educational attainment, often classified tracts as gentrifying even where such variables were stagnant or showed minimal change. Likewise, the Ding Index, expected to classify areas based on shifts in median family income and housing costs, failed to align its classifications with observable economic data. These systematic misalignments between the indices' theoretical frameworks and the actual socioeconomic data led to their exclusion in favor of the Sutton Index, which demonstrated more consistent and reliable adherence to its defined metrics for gentrification.

City Level Sutton Index

To see if the trends of gentrification status at the metro level applied to within the city boundaries for Atlanta, census tracts within the city area were sampled and new underlying index variable averages were created. Of the 161 census tracts in the Atlanta city area, 11 (7%) census tracts were classified as *nongentrifiable*, 88 (55%) were *eligible, but did not gentrify*, and 62 (39%) tracts were identified as *gentrifying*. *Nongentrifiable* tracts had the highest average median income of $153,361.00 in 2010 and $151,463.64 in 2018 compared to other city areas (Table 7). *Nongentrifiable* tracts also experienced a consistent level of high level of home ownership (75% % in 2010 and 84% in 2018) and share of persons with a college education or higher (43% in 2010 and 42% in 2018). Within these city tracts, the percentage of those who moved there within the last 10 years substantially decreased during the time period (60% in 2010 and 15% in 2018).

City tracts that were *eligible but did not gentrify* had an average median income of $60,175.60 in 2010 and $62,320.69 in 2018. These areas saw no change in the share of college educated residents (27% in 2010 and 27% in 2018) and homeownership levels (47% in 2010 and 44% in 2018). Additionally, eligible tracts experienced a decrease in the share of residents who move there in the last 10 years (71% in 2010 and 24% in 2018).

City area *gentrifying* tracts in 2010 had an average median income of $45,484.98, which increased to $54,293.19 in 2018 (Table 7). *Gentrifying* neighborhoods also experienced a slight increase in the share of residents with a college degree or higher (21% in 2010 and 23% in 2018), a slight decrease in the share of homeowners (45% in 2010 and 43% in 2018), and sizable

reduction in the share of residents who moved there in the last 10 years (73% in 2010 and 25% in 2018).

Gentrification and Canopy Coverage

The overall change in percent canopy cover within the Atlanta metro area was minimal, increasing by one percent during the study period (Table 8). In 2011, the metro area recorded 39% canopy cover and rose very slightly to 41% canopy in 2018. The change in canopy cover for the Atlanta city area resembled the small increases shown by the metro area. The Atlanta city area had lower overall canopy cover in both years than the metro area by around seven percent. Canopy coverage in the city area rose on average 0.6% between 2011 and 2018.

Stratifying the change in canopy cover by the selected Sutton gentrification index revealed no significant difference between index categories. On average, *eligible but did not gentrify* and *nongentrifiable* tracts experienced the largest increase in percent canopy cover, increasing 1.28% and 1.14% respectively (Table 8). *Gentrifying* tracts, on average, experienced an increase of 0.6% in percent canopy cover, similar to the overall experience of the Atlanta city area. Moreover, *gentrifying* areas began the period with an overall lower percent of their area covered by canopy than either *eligible but did not gentrify* and *nongentrifiable* areas with 33% of the are covered compared to 40% and 42% canopy coverage respectively. *Nongentrifiable* metro areas had the highest average percent canopy converge before and after the period (43% in 2011 and 44% in 2018).

Atlanta city's distribution of canopy coverage by the Sutton gentrification index classifications revealed a similar pattern of increase in coverage for *eligible but did not gentrify* and *gentrifying* areas but observed an, on average, decrease in the canopy coverage for *nongentrifiable* areas (Table 8). *Gentrifying* city areas had the lowest average canopy coverage at

27% in 2011 and saw no noticeable change in coverage over the time period. Conversely, nongentrifiable city areas had the highest average coverage at the beginning of the period, with 51% coverage, but underwent an average decrease of 0.4% by 2018.

Non-spatial linear models were constructed to produce estimates for the association of percent canopy coverage the varying Sutton gentrification index classification (Table 9). At the metro level, among *gentrifying* tracts, percent canopy coverage change was significantly different and -0.57 times the among *nongentrifiable* tracts (95% CI: (-1.04, -0.10)). Inversely, at the city level, percent canopy change was among gentrifiable tracts was 0.93 times the change among *nongentrifiable* tracts. However, at the city level, this association between *gentrifying* areas and canopy percent change was not significant (95% CI: (-0.24, 2.11)). Additionally, *gentrifying* and *eligible but did not gentrify* tracts were associated with significantly lower percent canopy cover in both 2011 and 2018 when compared to the percent canopy cover among *nongentrifiable* tracts.

Bayesian spatial regression models were also constructed to determine if there is a spatial relationship between gentrification status and percent canopy coverage change. There was no significant association in the change in percent canopy coverage when comparing either *gentrifying* or *eligible but did not gentrify* areas to the change in percent canopy coverage among *nongentrifiable* areas at both the Atlanta metro and city level (Table 10). However, there were significant associations between the three gentrification index classifications and the percent of canopy coverage within a single year. Compared to *nongentrifiable* areas within the metro area, *gentrifying* and *eligible, but did not gentrify* were inversely associated with five and four percent lower percent canopy coverage in both 2011 and 2018 respectively. This association of percent canopy cover within a year at the Atlanta city level is in the same direction as the metro

association and of a greater magnitude. These results indicate that location in important in the association between gentrification status and percent canopy coverage and the distribution of percent canopy coverage is not random.

Aim 3. Estimate where there is an association between neighborhood gentrification status, walkability, change in greenspaces over time and obesity prevalence.

Obesity Prevalence Associations

Unadjusted linear regression models were fitted to estimate the association between walkability, proportion of and changes in tree canopy cover, income-level, and the Sutton gentrification index classifications with obesity prevalence in the Atlanta area. Results from this unadjusted model showed lower obesity prevalence in the Atlanta metro area was associated with a higher income level, an increase in the percent tree canopy cover, and higher walkability status, with the "most walkable" tracts observing the lowest estimates (Table 11). Obesity prevalence also varied by gentrification status in the metro area. Compared to *nongentrifiable* census tracts, tracts that were *gentrifying* or *eligible, but did not gentrify* were associated with a seven to eight times increase in obesity prevalence (Table 11).

Associations between walkability, changes in canopy cover, and obesity prevalence were then examined through income adjusted and unadjusted models stratified at both the Atlanta metro and city levels. Additionally, models were stratified by Sutton gentrification index classification.

At the Atlanta metropolitan area level, there was a significant association between obesity prevalence and walkability before and after adjustment for tract income level and when stratified by gentrification status. Among *nongentrifiable* areas, lower obesity prevalence was associated

with an increase in area walkability in both models (Table 12). Obesity prevalence was five to six times lower within the most and above average walkable areas compared to the least walkable areas with the unadjusted model. Moreover, in the income adjusted model, obesity prevalence was eight times lower among most walkable areas compared to the least walkable (Table 12) Tree canopy cover was not significantly associated with obesity prevalence within these *nongentrifiable* metro tracts.

Of tracts that were *eligible, but did not gentrify*, obesity prevalence was significantly associated walkability and change in canopy cover. Within these areas, lower obesity prevalence was associated with an increase in more walkable areas and an increase in the proportion of tree canopy cover (Table 13). Moreover, obesity prevalence was six to eight times lower among the most walk able areas compared to the least walkable (Table 13). The patterns of associations were similar and significant in both the income adjusted and unadjusted models.

Obesity prevalence among *gentrifying* census tracts was significantly associated with walkability only when accounting for area level income. Among these census areas, areas with at least above average walkability had an obesity prevalence three to six times lower than the least walkable areas. areas with the highest walkability (Table 14). In the unadjusted model, only percent canopy change was significantly associated obesity prevalence, however this relationship was attenuated and nonsignificant in the income adjusted model.

The pervious analysis was replicated using census tracts contained within the Atlanta city area. Associations of obesity prevalence from the unadjusted city model were similar to the results of the metro level analysis. Lower obesity was associated with an increase in canopy cover and increase in the walkability of an area. When the city level models were stratified by the Sutton gentrification classifications, there were no significant associations between obesity

prevalence and walkability or change in canopy cover (Tables 15,16,17). Results demonstrate a large amount in variation within obesity prevalence in the city area.

Discussion

Comparing Gentrification Indices in Atlanta

This study of the Atlanta Metropolitan area leverages publicly available data to shed light on the patterns and associations between census tract level gentrification, greenspace change, and obesity prevalence. Given the increased interest in understanding the health impacts of gentrification and influence as a social determinant of health, the study's research aims sought to compare and constant three indices of gentrification, select one index that provides the most accurate classification of gentrification, and describe differences and associations between the chosen index, green space change, and obesity prevalence. These findings offer a nuanced examination of gentrification's multifaceted context-dependent associations, revealing its complex interplay with neighborhood economic transformations and public health outcomes.

The Sutton, Freeman, and Ding gentrification indices revealed distinct perspectives on gentrification in the Atlanta-Sandy Springs Metro Area, with each using different criteria to classify census tracts, resulting in varied implications for urban development and socio-economic changes. The methodologies employed for creating the indices provide a robust framework to assess the dynamics of gentrification in the Atlanta metropolitan area. The differential outcomes observed across the three indices underscore the importance of the methodological underpinnings in interpreting gentrification. The Sutton gentrification index, by focusing on home ownership, educational attainment, and resident demographics over time, highlights areas undergoing subtle socio-economic shifts. In contrast, the Freeman Index emphasizes economic factors like housing development and housing value change, pointing towards more pronounced neighborhood economic shifts. Meanwhile, the Ding Index, focusing on financial upgrading and educational status influx, identifies neighborhoods undergoing rapid and visible transformations.

The sensitivity analysis performed to estimate agreement rates between the indices demonstrates the variability in gentrification characterization when applied to the Atlanta metro area.

The Sutton Index identified 13% of tracts as gentrifying, a proportion of neighborhoods considerably higher than the 1% identified by the Freeman Index but lower than the 33% by the Ding Index. This suggests a discrepancy between the indices in defining and identifying gentrification within in the Atlanta Metro area. In comparison to the Urban Displacement Project, the Sutton Index more closely aligns with their publicly referenced criteria for gentrification in Atlanta (Chapple et al., 2024). The Urban Displacement Project utilizes a comprehensive methodology to depict neighborhood changes, providing a detailed context and nuanced understanding. Given these results, the Sutton Index should be considered more seriously when selecting an index to identify gentrifying areas.

The demographic shifts in *gentrifying* tracts also raise concerns about the displacement of long-standing communities and the affordability crisis. Nongentrifiable tracts, across all indices, were properly classified with higher median incomes and greater stability in terms of educational attainment and homeownership. These areas are indicative of well-established communities, that may have been historically high income or gentrified in a previous time, with characteristics such as high property values and resident stability. Gentrifying tracts across the indices, particularly in the Sutton and Ding, exhibited increases in median income and educational levels, alongside a drop in long-term residents, which aligns with typical gentrification patterns where economic and social upliftment occurs at the cost of original community displacement (Atkinson, 2000; Freeman, 2005). While gentrification can lead to revitalized neighborhoods and improved infrastructure, it often results in increased property values and living costs that exclude lower-income residents (Ding & Hwang, 2020). Among nongentrifiable tracts, there was substantial

decrease in the percentage of residents who moved there in the last ten years (from 57% to 15%) supports this previous displacement idea.

Greenspace Dynamics and Gentrification in Atlanta

This assessment of greenspace through canopy cover offers a critical ecological lens on the transformations associated with urbanization and gentrification. Research has shown that urbanization leads to a reduction in canopy covers due to the increase in built environments (Derkzen et al., 2017; Zhou & Wang, 2011). However, the relationship between gentrification specifically and greenspace is more nuanced. Gentrification can lead to the revitalization of parks and green spaces, potentially increasing canopy cover in certain neighborhoods as part of efforts to enhance property values and attract higher-income residents (Wolch et al., 2014). Conversely, it was found that greening efforts can vary significantly between neighborhoods based on socioeconomic factors, with wealthier areas receiving more substantial improvements in greenspace quality and accessibility (Boone et al., 2009).s

Findings from the study suggest that changes in canopy cover are weakly associated with any gentrification status. While the overall change in percent canopy cover across the city was minimal, there were significant differences in the actual amount of canopy cover present within each year. Baseline levels of greenspace already differed significantly across classification of gentrification status, suggesting some areas may possess more established or extensive greenspaces, potentially due to historical planning or other socioeconomic factors that pre-date the study period. Moreover, this result emphasizes the importance of not only focusing on the rate of greenspace change but considering the existing distribution and accessibility greenspaces

as well. By doing so, researchers will be better able to identify areas of disparity that require targeted interventions to ensure equitable access to greenspace.

Quantifying changes in greenspace and their association with gentrification status provide a critical link to understanding environmental social determinants of public health. To harness the full potential of urban greenspaces, future efforts must be designed to ensure all residents, regardless of socioeconomic status, can enjoy the health and environmental benefits that greenspace provides (Kondo et al., 2018).

Obesity Trends in Gentrifying Atlanta

The analysis of obesity prevalence in relation to gentrification, walkability, and changes in canopy cover offers a look at the intersection of metropolitan characteristics and the distribution of critical public health risk factor. Statistical models were utilized to quantify the relationships between physical environment variables and the current distribution of obesity in Atlanta. Findings indicate that obesity prevalence is inversely related to neighborhood walkability and canopy coverage. This suggests areas with improved pedestrian infrastructure and more canopy cover tend to have lower rates of obesity. Moreover, the gentrification status of a neighborhood exacerbates health disparities. *Gentrifying* and *eligible but not gentrified* census tracts had seven to eight times the prevalence of obesity when compared to *nongentrifiable* areas. The association of lower obesity prevalence with higher income levels and increased walkability within census tracts suggests that socioeconomic status and urban design play crucial roles in the distribution of obesity prevalence.

This study's findings regarding obesity prevalence in the context of gentrification, walkability, and canopy cover contribute significant insights to the literature on urban public

health. These results underscore the importance of neighborhood design elements that promote physical activity and provide natural spaces. However, as the data on obesity is cross-section, it cannot be concluded if the lower prevalence of obesity are the effect of neighborhood improvement or the result of an influx of wealthier, and often healthier, residents (Dickman et al., 2017).

Limitations

One of the primary limitations of this study is the potential issue of generalizability. The findings are based on data from the Atlanta metropolitan area, which, while comprehensive, may not represent the dynamics of gentrification and its impacts on greenspace and public health in other urban contexts with different economic compositions and urban planning histories. Results obtained from one metropolitan area may not be directly applicable to another area, and the context of each area must be accounted for in the interpretation of associations.

Another limitation is the study's cross-sectional design of modeling obesity prevalence. While this type of study design can effectively highlight correlations between variables at a specific point in time, it is less capable of establishing causality between factors. However, gentrification status was calculated longitudinally, which may provide more validity to the underlying directionality of the associations. While associations between walkability, greenspace, and obesity were identified, it cannot be determined if changes in greenspace or walkability cause changes in obesity prevalence without longitudinal obesity data.

While the associations found provide valuable insights into the relationships between gentrification, greenspace, and public health, it also highlights the importance of further studies that use longitudinal data, involve multiple cities, and incorporate more detailed and localized measurements of health and environmental variables (Smith & Thorpe, 2020). Such studies will enhance our understanding of the effects of urban revitalization and help in developing more targeted and effective urban planning and public health interventions for those affected.

Public Health Implications

This study indicates a clear need for integrated urban planning and public health strategies that consider the complex interactions between gentrification, environmental changes, and health outcomes. By highlighting the discrepancies among the indices in how gentrification is identified and interpreted, the findings reveal the complexity of urban transformations and their varied impacts on community health. Areas classified as *nongentrifiable*, defined by wealthier and higher educated neighborhoods, exhibited the lowest obesity prevalence when compared to gentrifying areas. In contrast, areas undergoing gentrification had populations with significantly higher prevalence of obesity. Urban planners and public health officials should work collaboratively to design interventions that not only improve physical infrastructure but also retain and maintain public green space access and density.

The analysis of greenspace, specifically changes in canopy cover, revealed significant disparities in greenspace availability across different urban areas, with wealthier, *nongentrifiable* census tracts displaying more extensive greenspace than those *gentrifying*. As access to greenspace is known to contribute positively to mental and physical health by promoting physical activity, reducing stress, and improving air quality, this contrast between gentrification status highlights a critical area for public health concern (Kaczynski & Henderson, 2007; Nowak et al., 2006; Roe & Aspinall, 2011). The uneven distribution of greenspace can exacerbate health disparities, particularly in lower-income neighborhoods that are also experiencing rapid urban change. Therefore, urban planners and public health professionals should advocate for equitable greenspace distribution in city planning initiatives, ensuring that all residents benefit from public health improvements associated with accessible natural environments.

Findings from this study demonstrated a clear association between neighborhood walkability, greenspace, and obesity prevalence. Neighborhoods with higher walkability and greater canopy coverage tended to exhibit lower rates of obesity. This suggests that urban design features that encourage physical activity—such as pedestrian-friendly streets and well-maintained public parks—are crucial for attenuating obesity in urban populations. However, the impact of these features varied by gentrification status, with gentrifying areas not showing the expected health benefits, possibly due to the social and economic upheavals that can accompany gentrification processes. This underscores the importance of implementing comprehensive public health strategies that not only improve physical infrastructure but also address the broader factors contributing to health disparities. Ensuring that public redevelopment includes health-promoting features accessible to all community members is essential for mitigating the adverse effects of gentrification on public health.

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Figures and Tables

Index Variables	Sutton Gentrification Index		
	Nongentrifiable	***Eligible, but did not gentrify***	***Gentrifying***
2010 Values			
Population 25+ 2010	3693	3579	2763
% Population High Education 2010	39%	19.44%	21%
% Home Ownership 2010	87%	64%	57%
% Residents Short Tenure 2010	57%	67%	70%
% Housing Built 2010	50%	44%	36%
Average Household Income 2010	$124,278.87	$63,221.74	$56,317.61
Average Home Value 2010	$413,224.74	$216,287.90	$232,465.50
Average Rent 2010	$1,527.83	$1,106.67	$1,034.91
2018 Values			
Population 25+ 2018	4228	4123	3232
% Population High Education 2018	38%	21%	23%
% Home Ownership 2018	84%	59%	55%
% Residents Short Tenure 2018	15%	20%	22%
% Housing Built 2018	23%	26%	33%
Average Household Income 2018	$121,196.79	$61,571.60	$62,364.72
Average Home Value 2018	$394,367.46	$189,469.49	$215,752.89
Average Rent 2018	$1,692.95	$1,122.68	$1,128.41

Table 1: Average values for Sutton Gentrification Index across all variables used for any index creation at the Atlanta metro level.

Index Variables	Freeman Gentrification Index		
	Nongentrifiable	***Eligible, but did not gentrify***	***Gentrifying***
2010 Values			
Population 25+ 2010	3741	3154	2729
% Population High Education 2010	29%	13%	15%
% Home Ownership 2010	78%	52%	23%
% Residents Short Tenure 2010	64%	69%	79%
% Housing Built 2010	51%	34%	20%
Average Household Income 2010	$88,507.63	$45,636.38	$41,753.29
Average Home Value 2010	$302,182.97	$164,998.61	$196,689.00
Average Rent 2010	$1,277.45	$974.29	$1,018.14
2018 Values			
Population 25+ 2018	4389	3527	3237
% Population High Education 2018	30%	15%	22%
% Home Ownership 2018	74%	45%	28%
% Residents Short Tenure 2018	18%	22%	28%
% Housing Built 2018	30%	22%	8%
Average Household Income 2018	$89,380.06	$42,378.10	$45,646.43
Average Home Value 2018	$283,754.55	$129,855.29	$226,328.57
Average Rent 2018	$1,362.54	$967.32	$1,074.14

Table 2: Average values for Freeman Gentrification Index across all variables used for any index creation at the Atlanta metro level.

Index Variables	Ding Gentrification Index		
	Nongentrifiable	***Eligible, but did not gentrify***	***Gentrifying***
2010 Values			
Population 25+ 2010	3862	2836	3274
% Population High Education 2010	29%	16%	15%
% Home Ownership 2010	82%	47%	54%
% Residents Short Tenure 2010	62%	72%	68%
% Housing Built 2010	52%	33%	37%
Average Household Income 2010	$94,407.98	$45,903.60	$47,126.51
Average Home Value 2010	$310,958.67	$200,094.25	$168,544.55
Average Rent 2010	$1,316.76	$946.41	$1,005.25
2018 Values			
Population 25+ 2018	4515	3244	3694
% Population High Education 2018	30%	21%	15%
% Home Ownership 2018	77%	45%	48%
% Residents Short Tenure 2018	17%	25%	22%
% Housing Built 2018	30%	26%	22%
Average Household Income 2018	$91,977.55	$51,121.12	$45,756.64
Average Home Value 2018	$288,497.04	$185,606.49	$135,363.96
Average Rent 2018	$1,395.12	$1,037.11	$984.82

Table 3: Average values for Ding Gentrification Index across all variables used for any index creation at the Atlanta metro level.

Sutton Index	Freeman Index				Total
	Missing	*Nongentrifiable*	*Eligible, but did not gentrify*	*Gentrifying*	
Missing	3	3	1	0	7
Nongentrifiable	0	126	0	0	126
Eligible, but did not gentrify	2	365	322	6	695
Gentrifying	0	56	66	1	123
Total	5	550	389	7	951
Overall Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	0%	0%	0%	0%	1%
Nongentrifiable	0%	13%	0%	0%	13%
Eligible, but did not gentrify	0%	38%	34%	1%	73%
Gentrifying	0%	6%	7%	0%	13%
Total	1%	58%	41%	1%	100%
Distribution of Ding Based on Sutton Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	60%	1%	0%	0%	1%
Nongentrifiable	0%	23%	0%	0%	13%
Eligible, but did not gentrify	40%	66%	83%	86%	73%
Gentrifying	0%	10%	17%	14%	13%
Total	100%	100%	100%	100%	100%

Table 4: Sutton Gentrification Index and Freeman Gentrification Index Classification Comparison

Sutton Index	Ding Index				Total
	Missing	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	
Missing	3	2	1	1	7
Nongentrifiable	0	126	0	0	126
Eligible, but did not gentrify	3	306	109	277	695
Gentrifying	1	39	46	37	123
Total	7	473	156	315	951
Overall Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	0%	0%	0%	0%	1%
Nongentrifiable	0%	13%	0%	0%	13%
Eligible, but did not gentrify	0%	32%	11%	29%	73%
Gentrifying	0%	4%	5%	4%	13%
Total	1%	50%	16%	33%	100%
Distribution of Ding Based on Sutton Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	43%	0%	1%	0%	1%
Nongentrifiable	0%	27%	0%	0%	13%
Eligible, but did not gentrify	43%	65%	70%	88%	73%
Gentrifying	14%	8%	29%	12%	13%
Total	100%	100%	100%	100%	100%

Table 5: Sutton Gentrification Index and Ding Gentrification Index Classification Comparison

Freeman Index	Ding Index				Total
	Missing	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	
Missing	5	0	0	0	5
Nongentrifiable	0	443	57	50	550
Eligible, but did not gentrify	2	30	94	263	389
Gentrifying	0	0	5	2	7
Total	7	473	156	315	951
Overall Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	1%	0%	0%	0%	1%
Nongentrifiable	0%	47%	6%	5%	58%
Eligible, but did not gentrify	0%	3%	10%	28%	41%
Gentrifying	0%	0%	1%	0%	1%
Total	1%	50%	16%	33%	100%
Distribution of Ding Based on Freeman Agreement	***Missing***	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***	**Total**
Missing	71%	0%	0%	0%	1%
Nongentrifiable	0%	94%	37%	16%	58%
Eligible, but did not gentrify	29%	6%	60%	83%	41%
Gentrifying	0%	0%	3%	1%	1%
Total	100%	100%	100%	100%	100%

Table 6: Freeman Gentrification Index and Ding Gentrification Index Classification Comparison

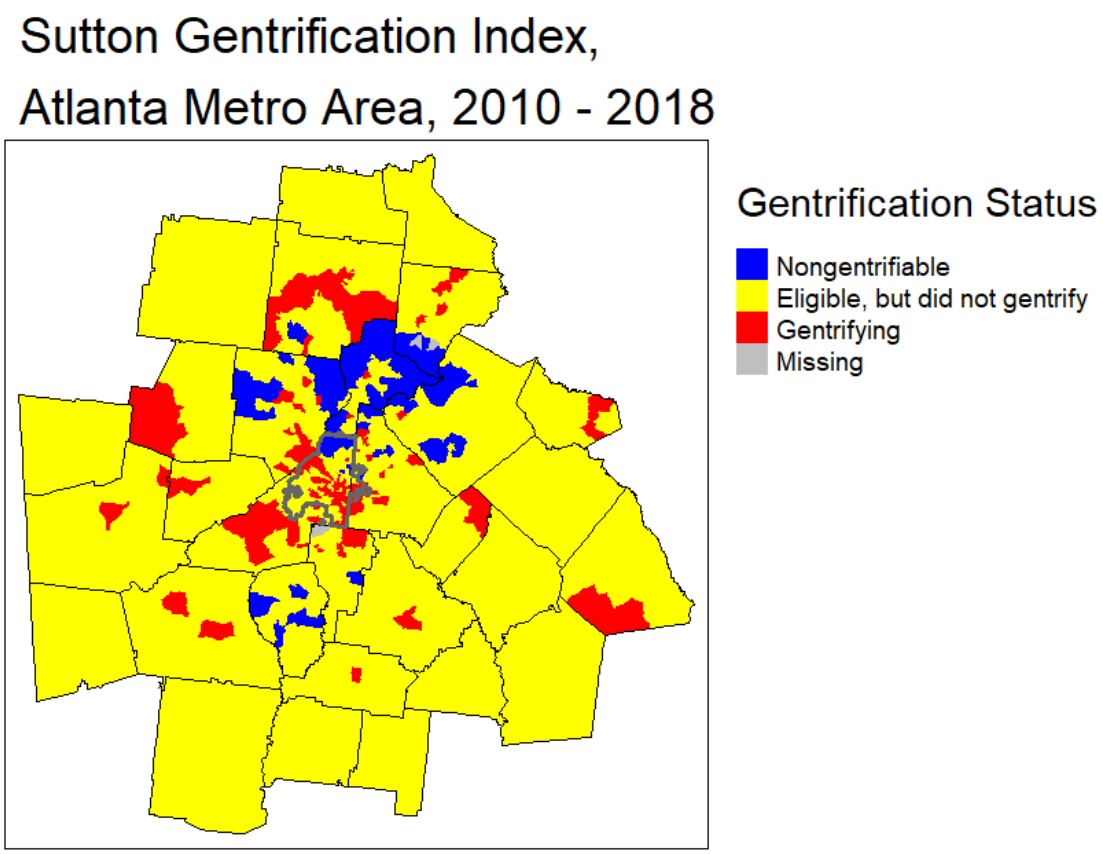

Figure 1: Sutton Gentrification Index across the Atlanta Metro Area (Atlanta, Sandy Springs, Roswell Area). Atlanta city boarders shown in grey outline.

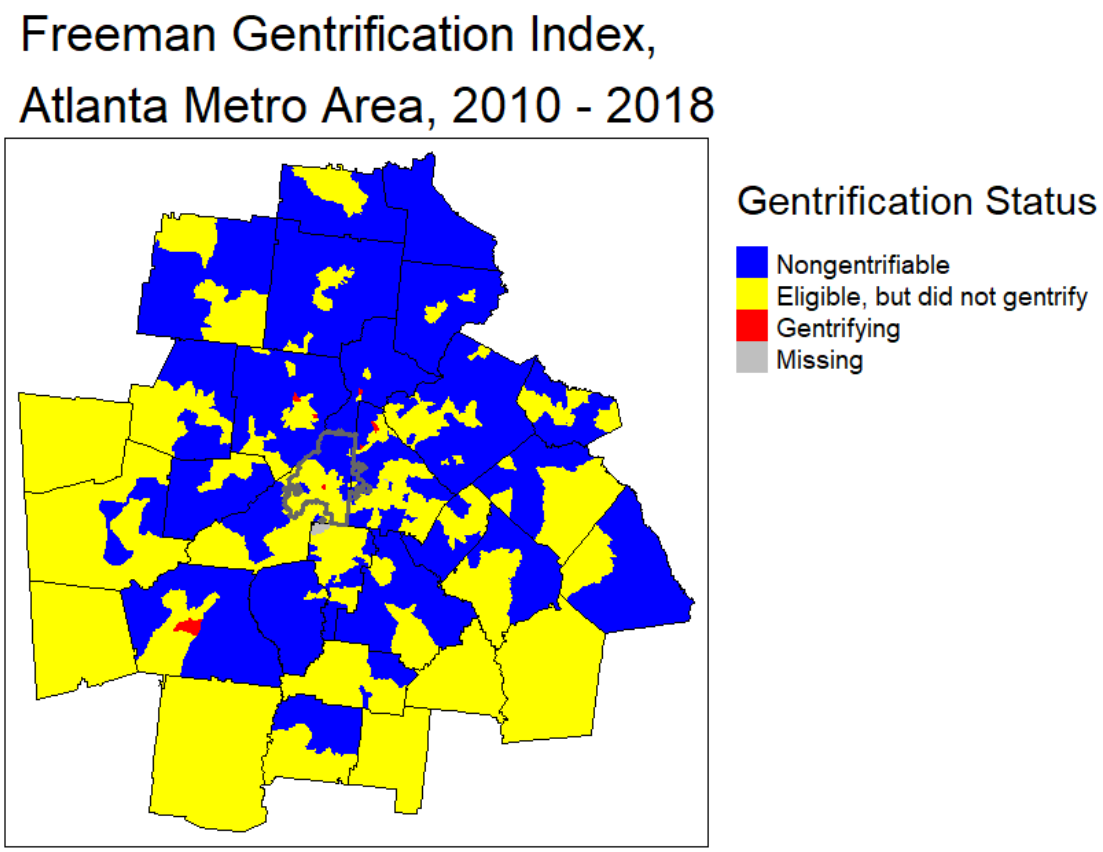

Figure 2: Freeman Gentrification Index across the Atlanta Metro Area (Atlanta, Sandy Springs, Roswell Area). Atlanta city boarders shown in grey outline.

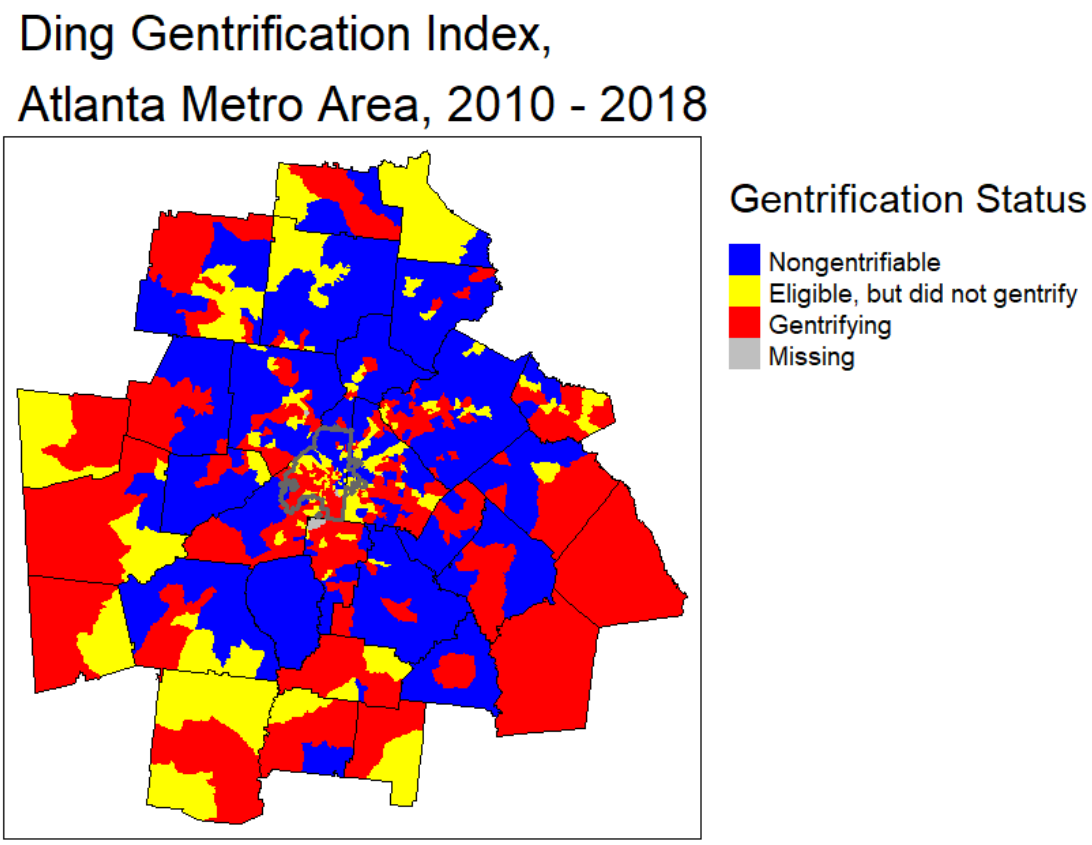

Figure 3: Ding Gentrification Index across the Atlanta Metro Area (Atlanta, Sandy Springs, Roswell Area). Atlanta city boarders shown in grey outline.

Index Variables	**Sutton Index (City Area)**		
2010 Values	***Nongentrifiable***	***Eligible, but did not gentrify***	***Gentrifying***
Population 25+ 2010	2911	2624	1974
% Population High Education 2010	43%	27%	21%
% Home Ownership 2010	75%	47%	45%
% Residents Short Tenure 2010	60%	71%	73%
% Housing Built 2010	29%	29%	30%
Average Household Income 2010	$153,361.00	$60,175.60	$45,484.98
Average Home Value 2010	$783,773.91	$309,477.88	$230,069.48
Average Rent 2010	$1,361.64	$1,064.43	$942.69
2018 Values			
Population 25+ 2018	3233	3108	2278
% Population High Education 2018	42%	27%	23%
% Home Ownership 2018	75%	44%	43%
% Residents Short Tenure 2018	19%	24%	25%
% Housing Built 2018	22%	25%	31%
Average Household Income 2018	$151,463.64	$62,320.69	$54,293.19
Average Home alue 2018	$765,909.09	$270,208.24	$220,375.00
Average Rent 2018	$1,689.90	$1,145.62	$1,066.06

Table 7: Average values for Sutton Gentrification Index across all variables used for any index creation at the Atlanta city level.

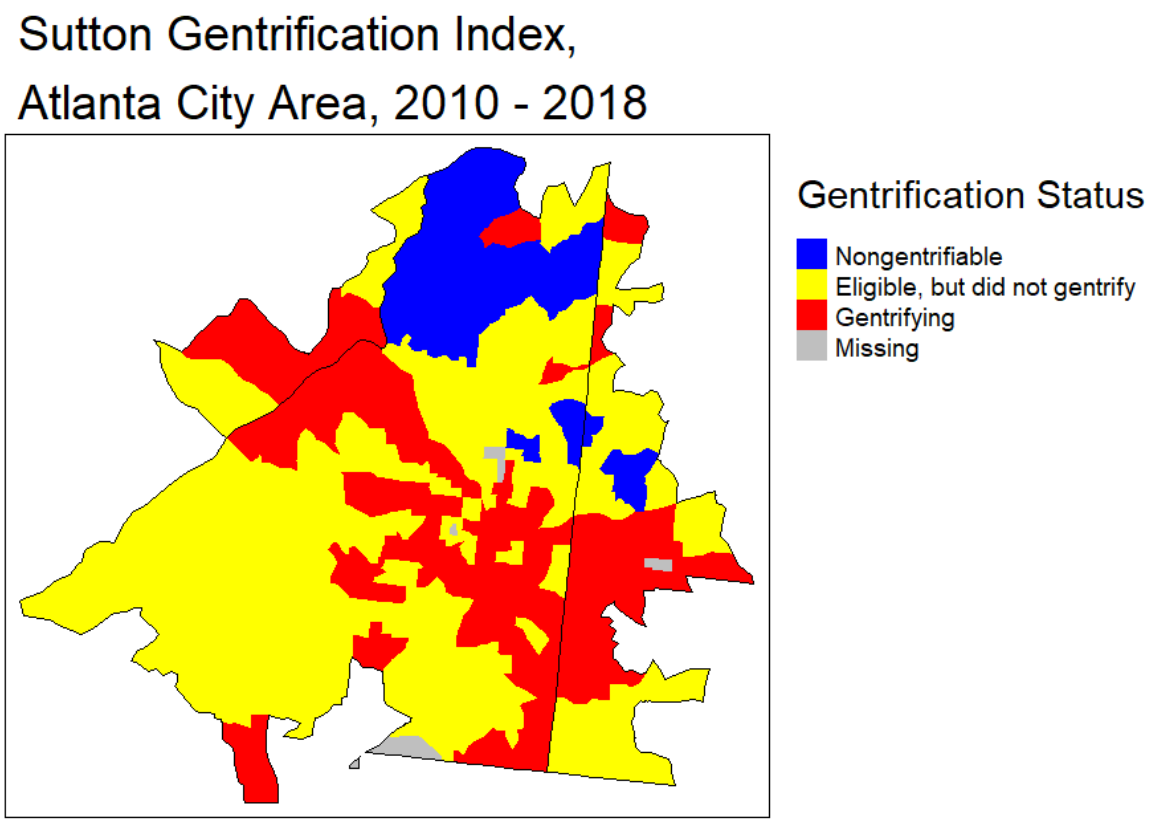

Figure 4: Sutton Gentrification Index across the Atlanta City Area (Atlanta, Sandy Springs, Roswell Area)

% Canopy Cover	Sutton Gentrification Index						Overall	
	Nongentrifiable		*Eligible, but did not gentrify*		*Gentrifying*			
Metro Area	***Mean***	***95% Confidence Interval***	***Mean***	***95% Confidence Interval***	***Mean***	***95% Confidence Interval***	***Mean***	***95% Confidence Interval***
2011	42.38 %	(24.59, 60.16)	39.76%	(16.12, 63.40)	33.76%	(4.51, 63.01)	39.33%	(15.13, 63.53)
2018	43.52 %	(26.67, 60.37)	41.04%	(17.60, 64.48)	34.33%	(5.22, 63.45)	40.50%	(16.47, 64.53)
% Change	1.14%	(-2.26, 4.55)	1.28%	(-2.55, 5.11)	0.58%	(-3.31, 4.46)	1.17%	(-2.64, 4.98)
City Area								
2011	51.08 %	(27.64, 74.52)	34.76%	(5.35, 64.16)	26.76%	(-2.45, 55.97)	32.79%	(1.38, 64.20)
2018	50.68 %	(28.41, 72.94)	35.52%	(5.59, 65.46)	27.29%	(-1.36, 55.94)	33.39%	(2.07, 64.71)
% Change	-0.40%	(-2.88, 2.08)	0.77%	(-2.62, 4.15)	0.53%	(-3.57, 4.63)	0.60%	(-3.06, 4.25)

Table 8: Average Percent Canopy Cover by Sutton Gentrification Index

Non-Spatial Linear Regression	% Canopy 2011		% Canopy 2018		% Change in Canopy	
Sutton Gentrification Index	***Coefficient***	***95% Confidence Interval***	***Coefficient***	***95% Confidence Interval***	***Coefficient***	***95% Confidence Interval***
Metro Area						
Intercept	42.38	(40.30, 44.45)	43.52	(41.46, 45.57)	1.14	(0.81, 1.47)
Eligible-Nongentrifiable	-2.62	(-4.88, -0.36)	-2.48	(-4.71, -0.25)	0.14	(-0.22, 0.50)
Gentrifying-Nongentrifiable	-8.62	(-11.57, -5.66)	-9.19	(-12.11, -6.26)	-0.57	(-1.04, -0.10)
City Area						
Intercept	51.08	(42.45, 59.71)	50.68	(42.04, 59.31)	-0.40	(-1.48, 0.68)
Eligible-Nongentrifiable	-16.32	(-25.48, -7.17)	-15.15	(-24.31, -5.99)	1.17	(0.03, 2.32)
Gentrifying-Nongentrifiable	-24.32	(-33.69, -14.95)	-23.39	(-32.76, -14.01)	0.93	(-0.24, 2.11)

Table 9: Non-spatial linear regression models between Sutton gentrification index classification and canopy coverage in Atlanta, GA among metro and city area census tracts

Bayesian Spatial Regression	% Canopy 2011		% Canopy 2018		% Change in Canopy	
Sutton Gentrification Index	***Coefficient***	***95% Confidence Interval***	***Coefficient***	***95% Confidence Interval***	***Coefficient***	***95% Confidence Interval***
Metro Area						
Intercept	42.73	(40.84, 44.61)	43.75	(42.14, 45.10)	0.70	(0.70, 1.39)
Eligible-Nongentrifiable	-3.97	(-6.21, -1.78)	-3.73	(-5.34, -1.97)	0.20	(-0.20, 0.56)
Gentrifying-Nongentrifiable	-4.50	(-6.80, -1.79)	-4.84	(-7.21, -2.48)	-0.20	(-0.69, 0.29)
City Area						
Intercept	42.80	(37.27, 48.14)	43.09	(36.75, 48.52)	0.58	(-0.32, 1.43)
Eligible-Nongentrifiable	-9.34	(-15.05, -3.13)	-8.94	(-15.04, -2.42)	0.15	(-0.77, 1.16)
Gentrifying-Nongentrifiable	-13.50	(-19.84, -7.59)	-13.34	(-19.41, -6.17)	-0.20	(-1.20, 0.84)

Table 10: Bayesian Spatial Regression of Percent Canopy Cover in 2011, 2018, and the Change in Cover by Gentrification Status. Nongentrifiable census tracts were used as the reference condition.

Unadjusted Regression Model: Metro Area	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Canopy Cover			
Canopy Cover 2018	-0.006	(-0.04, 0.03)	0.72
Change in Canopy Cover	-0.536	(-0.74, -0.33)	<0.001
Walkability			
Least walkable	Ref	(0.00, 0.00)	
Below average walkable	-1.73	(-2.79, -0.67)	0.001
Above average walkable	-1.66	(-2.83, -0.49)	0.006
Most walkable	-5.07	(-7.20, -2.93)	<0.001
Sutton Gentrification Index			
Nongentrifiable	Ref		
Eligible, but did not gentrify	8.07	(7.02, 9.12)	<0.001
Gentrifying	7.35	(5.98, 8.72)	<0.001
Income 2018	-0.00014	(-0.00015, -0.00013)	<0.001

Table 11: Unadjusted Linear Regression Model of obesity prevalence in 2021 and canopy cover, percent canopy change, walkability, Sutton gentrification status, and tract level income.

Regression Models: Nongentrifiable Metro Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	0.17	(-0.16, 0.49)	0.3
Least walkable	Ref	-	-
Below average walkable	-2.80	(-4.7, -0.84)	0.005
Above average walkable	-5.20	(-7.6, -2.7)	<0.001
Most walkable	-6.50	(-13, -0.22)	0.043
Income Adjusted			
Change in Canopy Cover	0.22	(-0.03, 0.47)	0.08
Least walkable	Ref	-	-
Below average walkable	-2.70	(-4.2, -1.2)	<0.001
Above average walkable	-5.40	(-7.3, -3.4)	<0.001
Most walkable	-8.50	(-13, -3.5)	<0.001
log(Income 2018)	-7.2	(-8.7, -5.6)	<0.001

Table 12: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Nongentrifiable metro areas.

Regression Models: Eligible but did not gentrify Metro Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	-0.49	(-0.71, -0.27)	<0.001
Least walkable	Ref	-	-
Below average walkable	-0.58	(-1.7, 0.50)	0.300
Above average walkable	-2.10	(-3.3, -0.95)	<0.001
Most walkable	-5.80	(-8.5, -3.1)	<0.001
Income Adjusted			
Change in Canopy Cover	-0.25	(-0.39, -0.11)	<0.001
Least walkable	Ref	-	-
Below average walkable	-1.10	(-1.7, -0.36)	0.003
Above average walkable	-5.20	(-6.0, -4.4)	<0.001
Most walkable	-7.50	(-9.2, -5.8)	<0.001
log(Income 2018)	-12	(-12, -11)	<0.001

Table 13: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Eligible but did not gentrify metro areas.

Regression Models: Gentrifying Metro Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	-0.87	(-1.4, -0.34)	0.002
Least walkable	Ref	-	-
Below average walkable	0.07	(-3.6, 3.7)	>0.9
Above average walkable	2.20	(-1.4, 5.7)	0.200
Most walkable	-2.30	(-6.4, 1.8)	0.300
Income Adjusted			
Change in Canopy Cover	-0.26	(-0.56, 0.05)	0.09
Least walkable	Ref	-	-
Below average walkable	-1.40	(-3.4, 0.68)	0.200
Above average walkable	-2.80	(-4.8, -0.71)	0.009
Most walkable	-5.90	(-8.2, -3.6)	<0.001
log(Income 2018)	-9.9	(-11, -8.7)	<0.001

Table 14: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Gentrifying metro areas.

Regression Models: Nongentrifiable City Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	0.06	(-0.50, 0.62)	0.8
Below average walkable	Ref	-	-
Above average walkable	0.46	(-0.65, 1.6)	0.40
Most walkable	0.66	(-1.5, 2.8)	0.50
Income Adjusted			
Change in Canopy Cover	-0.04	(-0.61, 0.53)	0.90
Below average walkable	Ref	-	-
Above average walkable	0.72	(-0.46, 1.9)	0.20
Most walkable	1.40	(-1.1, 3.9)	0.20
log(Income 2018)	1.6	(-1.2, 4.4)	0.20

Table 15: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Nongentrifiable city areas.

Regression Models: Eligible but did not gentrify City Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	-2.20	(-3.2, -1.3)	<0.001
Least walkable	Ref	-	-
Below average walkable	14.00	(-1.3, 29)	0.07
Above average walkable	10.00	(-4.8, 25)	0.20
Most walkable	7.90	(-7.4, 23)	0.30
Income Adjusted			
Change in Canopy Cover	-0.19	(-0.88, 0.49)	0.60
Least walkable	Ref	-	-
Below average walkable	2.70	(-6.7, 12)	0.60
Above average walkable	-1.80	(-11, 7.4)	0.70
Most walkable	-3.40	(-13, 6.0)	0.50
log(Income 2018)	-11	(-13, -9.3)	<0.001

Table 16: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Eligible but did not gentrify city areas.

Regression Models: Gentrifying City Areas	**Obesity Prevalence 2021**		
Variable	***Coefficient***	***95% Confidence Interval***	***P-Value***
Unadjusted			
Change in Canopy Cover	-1.10	(-1.8, -0.32)	0.01
Least walkable	Ref	-	-
Below average walkable	7.60	(-4.9, 20)	0.20
Above average walkable	8.40	(-3.4, 20)	0.20
Most walkable	3.40	(-8.7, 15)	0.60
Income Adjusted			
Change in Canopy Cover	-0.10	(-0.55, 0.35)	0.70
Least walkable	Ref	-	-
Below average walkable	-1.10	(-8.2, 6.1)	0.80
Above average walkable	-2.40	(-9.3, 4.5)	0.50
Most walkable	-5.60	(-13, 1.3)	0.11
log(Income 2018)	-9.3	(-11, -7.7)	<0.001

Table 17: Unadjusted and Income Adjusted Linear Regression Models of obesity prevalence in 2021 and percent canopy change and walkability among Gentrifying metro areas.