**Assessing Equity in Public Beach Access with Spatial Intersectionality**

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by

Jinwon Kim*

Assistant Professor,

Department of Tourism, Hospitality and Event Management, University of Florida,

FLG 190D, P.O. Box 118208, Florida Gym, Gainesville, 32611, USA

E-mail: jinwonkim@ufl.edu

Phone: +1-352-294-1625

Seongsoo Jang

Senior Lecturer (Associate Professor),

Cardiff Business School, Cardiff University,

S46, Aberconway Building, Colum Road, Cathays, Cardiff, CF10 3EU, UK

E-mail: JangS@cardiff.ac.uk

Phone: +44-292-087-4552

* Corresponding author

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## Abstract

Previous research on beach access typically uses socioeconomic variables such as race/ethnicity and different levels of wealth to identify marginalized groups. Such an additive approach, however, fails to consider the inter-categorical intersectionality between variables when defining marginalized groups. Moreover, there is little research that assesses the spatial variability of intersectional groups in relation to public beach access. This study addressed these gaps by empirically examining the spatially heterogeneous inter-categorical intersectionality of race/ethnicity and poverty in terms of public beach access. A geographically weighted regression was employed via a case study of 784 census tracts in the Metro Detroit. The results showed that economically marginalized white neighborhoods, overall, were more accessible to public beaches than economically marginalized African American and Asian neighborhoods. Furthermore, there exists spatially heterogeneous (in)equitable access to public beaches depending on the type of intersectional composition of the neighborhood. These findings are useful for beach managers to allocate resources to neighborhoods in need of more access to public beaches.



*Keywords:* Public beach access, equity, spatial inter-categorical intersectionality, geographically weighted regression, spatial heterogeneity

## Assessing Equity in Public Beach Access with Spatial Intersectionality

Public beach access is a civil right according to the U.S. public trust doctrine (Kim and Nicholls 2018), and it enhances residents' well-being and quality of life (Lee et al. 2020). Previous studies have documented significant inequitable access to beaches with regard to race/ethnicity and wealth status (Kim and Nicholls 2016, 2018; Montgomery et al. 2015). Scholars highlight that beach management strategies and their political drivers that are commonly used worldwide are criticized from the perspective of social justice (Cooper and McKenna 2008). Some stakeholders, including local residents, feel excluded or less involved in the beach management and decision-making process (Ariza et al. 2014). Thus, it has been argued that the limited beach access of marginalized groups, such as low-income earners and racial/ethnic minority groups, can be conceptualized as one of the main environmental injustice issues (Kim et al. 2021).

Although several environmental justice (EJ) studies have empirically measured the (in)equity of public beach access, they have typically studied race/ethnicity (e.g., non-whites and African Americans) and ranging levels of wealth (e.g., household income and poverty) factors separately as determinants of inequitable access to public beaches (Kim et al. 2019; Kim and Nicholls 2016). However, such an additive approach does not often reflect the intersectionality between socioeconomic categories when defining the marginalized groups (Jang and Kim 2018). The term *intersectionality* refers to the interconnected nature of social categorizations such as race, class, poverty, and gender in creating individuals' unique experiences of discrimination (Crenshaw 1991). According to Watson and Scarton (2013), "thinking intersectionally offers leisure scholars potential to engage with difference in more meaningful ways than a mere recognition of plurality and diversity" (p. 44). Thus, the literature on intersectional EJ research

has made a distinction between inter-categorical and intra-categorical analysis. Inter-categorical analysis aims to describe the associations of inequality among multiple social groups/categories (Lievanos 2019), in contract with the intra-categorical approach, which focuses on the inequality outcomes within particular social groups (Grineski et al. 2019). While measuring the equity of public beach access with an intersectional lens is required, little empirical study has been done in this direction. Although Montgomery et al. (2015) conducted the intra-categorical analysis to assess the EJ of public beach access in Metro Miami, based on our knowledge, no inter-categorical analysis of public beach access has been conducted.

Social stratification and recreational inequity are closely related to location. According to the deprivation amplification hypothesis, marginalized groups are more likely to be exposed to physical deprivation by their residential environment, amplifying social and environmental inequities (Schneider et al. 2019). Hence, the prevalence of marginalized groups in a certain community could result in less equitable recreation environments than in other less marginalized communities. Understanding the inequitable access to beaches faced by marginalized communities requires a further examination of community-based spatial heterogeneity because each community has created unique socioecological structures that could determine different levels of public beach access. Soja (2010) stated that uneven social conditions are related to "consequential geographies" (p. 97), which can accelerate segregation or inequitable access to opportunities such as public beach access. However, there is limited research that has explored the spatial heterogeneity of public beach access from an intersectional perspective on sociodemographic categories across communities.

To fill these gaps in research, this study examined the spatially heterogeneous inter-categorical intersectionality of two social categories—race/ethnicity and poverty (e.g., white

poverty, African American poverty, and Asian poverty)—in terms of public beach access across 784 census tracts (CTs) in the Detroit Metropolitan Area (DMA). Specifically, this study (1) addressed whether access to public beaches in the DMA is equitably distributed across communities with high percentages of white poverty, African American poverty, and Asian poverty neighborhoods and (2) examined spatial heterogeneity in the association between public beach access and intersectional categories across CTs. The DMA was selected as the study area because it has diverse racial/ethnic compositions with a high density of public beaches (Kim and Nicholls 2018). The CT was used as the unit of analysis due to its homogeneity in socioeconomic status (Jang and Kim 2018). Findings of this study can contribute to the recreation equity literature as a practical application of (1) adopting a spatially heterogeneous intersectional view of sociodemographic categories and (2) explicating public beach access to implement community-based recreation interventions and policies.

The level of public beach access, a dependent variable, was measured by the shortest street network distance from each CT centroid to the nearest public beach. GIS-based network analysis was used to measure the geographic distance. This access measure considered a minimum distance approach, assuming that recreation settings such as parks and beaches are typically used by nearby residents (Kim et al. 2021). The independent variables were the intersectional compositions of race/ethnicity and poverty. To measure the intersectional composition, this study used the percentage of each CT that integrated racial/ethnic composition and poverty level. These measures reflect a compensatory- or need-based equity, which includes allocating limited resources to those who need it the most (Crompton and Wicks 1988). Initially, we created four intersectional independent variables for each CT: white poverty, African American poverty, Hispanic poverty, and Asian poverty. However, we excluded the Hispanic

poverty variables in our equity model due to data availability. According to the 2011-2015 ACS, only 283 CTs out of 1,164 CTs (24.9%) was available to access the Hispanic poverty data in the DMA.

Five control variables—vehicle ownership, house value, income, poverty, and population density—were also used to represent disadvantaged groups that need more public beach access (Kim and Nicholls 2016, 2018; Kim et al. 2019; Montgomery et al. 2015). Beach location data such as latitude and longitude were acquired from the 2015 Michigan Department of Environment, Great Lake, and Energy. The intersectional census data were collected from the 2011-2015 American Community Survey 5-year estimates of the U.S. Census Bureau at the CT level. Table 1 summarizes all variables, their operational definitions, and data sources.

[Insert Table 1]

To investigate global and spatially varying relationships between intersectional social categories and public beach access, this study employed an ordinary least squares (OLS) regression and a geographically weighted regression (GWR) for the data analysis. While applying GWR, a bi-square kernel with adaptive bandwidth, which defines a specific number of neighbors (in this study, 126 CTs) was used due to the geographically different size of the CT units (Kim et al. 2021). To identify the optimal kernel bandwidth, an iterative statistical optimization was applied to minimize the Akaike Information Criterion (AIC). Furthermore, a spatial variability test of local coefficients was employed using the difference of criterion (DIFF) value (Jang and Kim 2022).

The results of the OLS model are presented in Table 2. The VIF ranged from 1.26 to 3.84, representing a lack of redundancy. White poverty ($\beta$=–1.592, $p$<0.05) was negatively related to public beach access, whereas African American poverty ($\beta$=2.036, $p$<0.05) and Asian

poverty (β=0.229, $p$<0.05) were positively related. These findings showed that overall CTs with a higher percentage of white poverty had more equitable access to public beaches, whereas those with a higher percentage of African American poverty and Asian poverty had relatively limited or inequitable access to public beaches. However, the OLS model did not capture spatial variability of intersectional groups in terms of public beach access. Thus, GWR was employed to explore and visualize spatial nonstationarity in local coefficients.

[Insert Table 2]

The GWR results are also presented in Table 2. The local $R^2$ ranged from 0.030 to 0.559 (mean: 0.198). The condition index ranged from 7.325 to 20.915, indicating the absence of collinearity issue among variables. The DIFF values for all intersectional independent variables were below -2, showing significant spatial variation of all local coefficients across CTs. The local coefficient of white poverty varied from –17.739 to 8.572 (mean=–0.447), those of African American poverty from –3.304 to 7.465 (mean=0.303) and those of Asian poverty from –1.321 to 4.253 (mean=0.497). Figure 1 shows how the local coefficients for three intersectionality variables and local $R^2$ in the GWR-based spatial equity model varied across 784 CTs in the DMA. Specifically, Figure 1a shows that white poverty groups in CTs in the northeastern parts of Macomb county and southern parts of Wayne county observed shorter distances (greater access) to public beaches, whereas those in CTs in the northwestern parts of Oakland and Wayne counties had relatively longer distances (limited access) to public beach access. Such spatial non-stationarity of local coefficients for African American poverty and Asian poverty was also observed in Figures 1b–1c. Finally, the GWR model identified spatial variability of the local $R^2$, which ranged from 0.030 to 0.559 (Figure 1d). This finding also indicates that the performance from the GWR model was spatially heterogeneous.

[Insert Figure 1]

Several conclusions can be drawn from this study with new questions for future research. First, economically marginalized white American neighborhoods had better access to public beaches than economically marginalized African American and Asian neighborhoods. This result enhanced our knowledge on recreation equity research because prior studies typically considered the race/ethnicity and wealth characteristics separately when measuring the equity in public beach access (Kim and Nicholls 2016, 2018; Kim et al. 2019). However, considering demographic factors (e.g., race/ethnicity) without economic factors (e.g., poverty) or economic factors without demographic factors may provide an incomplete picture of the potential importance of these intersectional categories in shaping the spatial accessibility of public beaches. Our findings provide strong empirical evidence to examine how the inter-categorical intersectionality of socioeconomic categories could better explain (in)equitable access to public beaches in the DMA. As the DMA can be further divided into urban and rural areas, future research can investigate whether these spatial differences in public beach access are different in urban and rural areas and across regions and countries.

Second, this study showed that there exists spatially heterogeneous relationships between intersectional groups and public beach access. This finding expands on existing intersectionality studies in recreation equity by providing empirical evidence of the importance of place-based beach deserts when allocating resources for public beach development and management. Traditional recreation equity research has typically examined "who gets what" in the context of environmental justice. This study, however, examined "who gets what, where, and to what extent" by identifying intersectionally marginalized neighborhoods in terms of limited or no access to public beaches across locations. This finding will help public beach managers better

understand local intersectional patterns of public beach access and remedy beach inequity in the DMA. As beach managers often need to estimate how residents and tourists place value on beach access, future research should reflect the spatial intersectionality of multiple social categories of both residents and tourists in the access to public beaches.

Despite the significant conclusions from this study, some limitations are presented. First, the distance-based access measure to the nearest beach access point in this study cannot reflect other important objective (e.g., environmental quality, size, crowding, and safety) and subjective factors (e.g., past experience and individual perception). These factors also could influence residents' destination choice, and thus they should be incorporated into future research. Second, although this study visualized the spatially heterogeneous (in)equity of public beach access, the findings still need additional study to address why the spatially heterogenous (in)equity of public beach access occurs. So, further studies using residential surveys and focus group interviews are required to examine the causal link between public beach access, intersectional minority, and space based on the deprivation amplification hypothesis or marginality theory.

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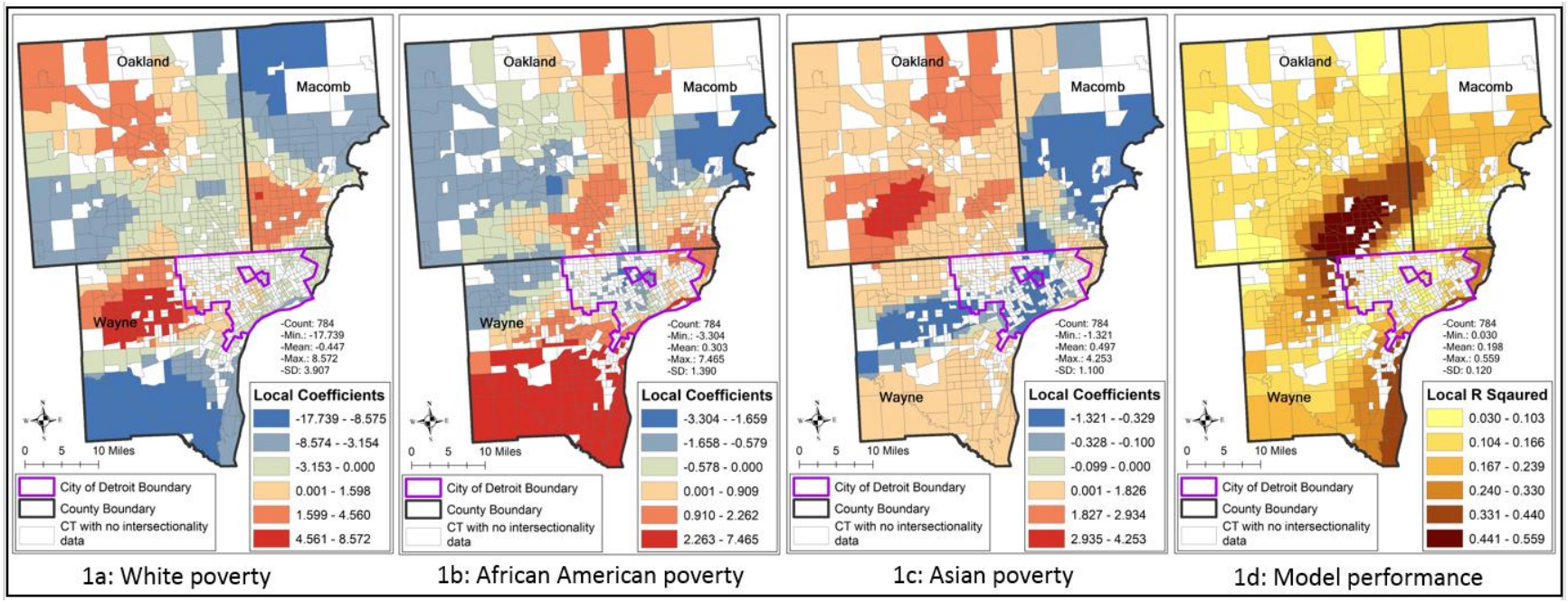


**Figure 1** *Spatial distribution of local regression coefficients and local* $R^2$.

***Table 1*** *Dependent and independent variables.*

| Variable | Operational definition | Source | Equity indicated when dependent variable... |
|---|---|---|---|
| Public beach access (DV) | Shortest street network distance from CT centroid to the nearest public beach (in miles) | MDEGE | |
| White poverty (IV) | Percentage (%) of White American population below the poverty line for each CT | 2011-2015 ACS | Decreases |
| African American poverty (IV) | Percentage (%) of African American population below the poverty line for each CT | - | Decreases |
| Asian poverty (IV) | Percentage (%) of Asian American population below the poverty line for each CT | - | Decreases |
| Vehicle ownership (CV) | Percentage (%) of household without a vehicle for each CT | - | Decreases |
| House value (CV) | Median home price ($) for each CT | - | Increases |
| Income (CV) | Median household income ($) for each CT | - | Increases |
| Poverty (CV) | Percentage (%) of population below the poverty line for each CT | - | Decreases |
| Population density (CV) | Population per square mile for each CT | - | Decreases |

Note: DV: dependent variable; IV: independent variable; CV: control variable; MDEGE: Michigan Department of Environment, Great Lake, and Energy; ACS: American Community Survey. All operational definitions for intersectional groups are official definition by the ACS.

***Table 2*** *Results of OLS and GWR models.*

| Variable | OLS coefficients | VIF | GWR coefficients (β) | | | DIFF | Spatial variability | Equity (inequity) indicated when value of coefficient |
|---|---|---|---|---|---|---|---|---|
| | β | | Min. | Mean | Max. | | | |
| Intercept | 7.117* | | -0.292 | 6.788 | 15.188 | -8.132 | | - |
| White poverty | -1.592* | 2.51 | -17.739 | -0.447 | 8.572 | -13.194 | Yes | Negative (positive) |
| African American poverty | 2.036* | 1.26 | -3.304 | 0.303 | 7.465 | -9.221 | Yes | Negative (positive) |
| Asian poverty | 0.229* | 1.30 | -1.321 | 0.497 | 4.253 | -6.751 | Yes | Negative (positive) |
| Vehicle ownership | -0.011* | 2.40 | -0.159 | -0.007 | 0.114 | -3.347 | Yes | Negative (positive) |
| House value | -0.010* | 2.01 | -0.030 | -0.003 | 0.037 | -4.024 | Yes | Postive (negative) |
| Income | -0.003 | 1.90 | -0.104 | -0.007 | 0.076 | 3.667 | | |
| Poverty | -0.003* | 3.84 | -0.113 | -0.006 | 0.145 | -2.985 | Yes | Negative (positive) |
| Population density | 0.000 | 1.35 | 0.000 | 0.000 | 0.001 | 3.191 | | |
| $R^2$ | 0.147 | | 0.030 | 0.198 | 0.559 | | | |
| Condition index | | | 7.325 | 12.693 | 20.915 | | | |
| $AIC_c$ | 4,255.08 | | | 4,183.11 | | | | |
| F-statistic | 16,703* | | | | | | | |
| Neighbors | | | | 126 | | | | |

Note. β (Beta): regression coefficient; *: $p < 0.05$; $AIC_c$: corrected Akaike's Informaiton Criterion; VIF: variance inflation factor; DIFF: difference of criterion value