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# Spatial Patterns of Constraints to Park Visitation among Urban Populations

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**ABSTRACT**

This article examined constraints to visiting urban parks and natural areas in the Portland, Oregon (USA) metropolitan region, as well as spatial attributes of these constraints. Data were obtained from questionnaires completed by 620 residents. Statistical analysis coupled with geographic information system (GIS) and hot spot analysis determined spatial patterns in constraint groups (least, moderate, most), different dimensions of constraints, and resident characteristics (white majority, racial and ethnic minorities). The northeast area of this region had the highest minority resident clustering, was most constrained in general, and was most constrained by health and lack of recreation partners in particular. Residents in the west and southwest areas were most constrained by limited access and knowledge related to parks. These results inform agency objectives associated with reaching and engaging various populations, including minorities. Findings also contribute to the literature by applying GIS analysis of survey data to understand spatial aspects of constraints.

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## Introduction

Urban parks offer a means of connecting with nature in the midst of bustling metropolitan areas, and these connections provide social, physical, and emotional benefits such as stress relief, improved physical health, and lower crime (Moore & Driver, 2005). Urban parks offer not only spaces in which to unwind and connect with nature, but also places for family bonding, social events, and learning. Some residents, however, may be constrained to visit these urban green spaces and receive these associated benefits as often as they would like. Constraints are factors that limit participation, affect leisure preferences, and/or reduce enjoyment and satisfaction from recreation experiences (Jackson, 2005). Examples of constraints include other obligations (e.g., work, family), difficulty affording costs of visiting parks, and inability to travel to parks.

Studies have shown that certain groups can be more likely to experience constraints to recreation participation and park visitation (Bustam, Thapa, & Buta, 2011; Byrne & Wolch, 2009; Floyd, Gramann, & Saenz, 1993; Green, Bowker, Wang, Cordell, & Johnson, 2009; Shinew & Floyd, 2005; Shinew, Floyd, & Parry, 2004; Stodolska & Yi-Kook, 2005). These groups include the elderly, physically and mentally disabled,

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low-income women, and racial and ethnic minorities (Shores, Scott, & Floyd, 2007). In many urban settings, some groups, such as low-income and minority residents, often cluster together in neighborhoods and census blocks located in the inner-city far from many parks and green spaces (Blahna & Black, 1993; Byrne & Wolch, 2009; Floyd et al., 1993; Gobster, 2002; Gómez, Baur, Hill, & Georgiev, 2015; Heynen, Perkins, & Roy, 2006; Wolch, Wilson, & Fehrenbach, 2005). Some common constraints of these groups, such as access to parks and residential distance from these and other green spaces, might also cluster together (Jackson, 1994). Therefore, it is possible that some constraints to urban park visitation may vary spatially and be related to demographic and residential patterns.

Despite trends of some traditionally constrained groups clustering together in neighborhoods and census blocks, limited research has examined connections between spatial attributes and constraints to recreation and park visitation. Jackson (1994) called for integrating geographic and social psychological research in studies of constraints by suggesting that "it is necessary not only to analyze spatial variations in constraints on recreation and leisure, but also to compare the relative explanatory power of space and place with other variables that may have a greater or lesser impact on people's leisure choices" (p. 111). Understanding how groups of residents (e.g., minorities) and their constraints cluster together and vary spatially across a setting can provide targeted locations for outreach and engagement designed to attract diverse audiences to parks and other natural areas. This article, therefore, analyzed data from a social science survey in a geographic information system (GIS) to examine spatial variations of constraints associated with visiting urban parks in the Portland, Oregon (USA) metropolitan region.

## Conceptual foundation

### *Constraints to recreation*

Although there are different frameworks for categorizing constraints (e.g., Jackson, 2005; Nadirova & Jackson, 2000; Stodolska & Jackson, 1998), Crawford and Godbey's (1987) model has been the most widely used (see Jackson, 2005; Manning, 2011 for reviews), and they categorized constraints as intrapersonal, interpersonal, and structural. *Intrapersonal constraints* "involve individual psychological states and attributes which interact with leisure preferences rather than intervening between preferences and participation" (Crawford & Godbey, 1987, p. 122). Examples of these constraints include stress, depression, and perceived ability in an activity. *Interpersonal constraints* relate to relationships or interactions with others, such as family obligations or differing leisure preferences among friends that inhibit recreation (Crawford & Godbey, 1987). *Structural constraints* are institutional, situational, and functional characteristics that constrain recreation (Crawford & Godbey, 1987). These constraints are often the most prevalent and include issues such as costs to recreate, lack of time, lack of information, and distance from recreation resources (Mowen, Payne, & Scott, 2005; Walker & Virden, 2005; Zanon, Doucouliagos, Hall, & Lockstone-Binney, 2013).

Some researchers have integrated these categories into a hierarchy where intrapersonal constraints are experienced first, followed by interpersonal and then structural constraints (Crawford, Jackson, & Godbey, 1991). Others, however, have found a

hierarchical approach to be problematic and their empirical studies have experienced mixed results confirming this model (Gilbert & Hudson, 2000; Hawkins, Peng, Hsieh, & Ekland, 1999; McQuarrie & Jackson, 1996; Zanon et al., 2013). As a result, some have adopted other approaches for categorizing constraints (Floyd, Shinew, McGuire, & Noe, 1994; Shinew & Floyd, 2005; Stodolska & Jackson, 1998). Most recently, for example, Stodolska, Shinew, and Camarillo (2019) found that common categories of constraints included cost, lack of knowledge about parks and opportunities in these areas, access and transportation, time (too busy), programs and facilities, safety concerns, and issues related to race and culture (e.g., profiling, undocumented immigrants, language barriers).

Constraints on recreation participation and park visitation can be influenced by age, race, gender, income, education, and other characteristics (see Jackson, 2005; Manning, 2011; Zanon et al., 2013 for reviews). Walker and Virden (2005) included race/ethnicity, gender, cultural/national forces, and socioeconomic forces as macro (i.e., broader, societal) level factors antecedent to constraints. Many of these factors act in unison and can have compounding effects on constraints (e.g., low-income elderly women of color are often most constrained, whereas educated young-adult white males can be least constrained; Jun, Kyle, & Mowen, 2009; Shores et al., 2007; Zanon et al., 2013). Numerous studies have found that racial and ethnic minorities experience more constraints compared to non-minorities (Bustam et al., 2011; Gobster, 2002; Metcalf, Burns, & Graefe, 2013; Shores et al., 2007; Wilhelm Stanis, Schneider, & Russell, 2009), whereas others have found that different factors, such as available resources and free time, contribute more to constraints (Jackson, 1994, 2005; Scott, 2013). Despite mixed results on the relative importance of certain demographics, race and ethnicity are commonly associated with constraints such as affordability of recreation, distance from parks, lack of transportation to parks, and crime in parks (Bustam et al., 2011; Byrne & Wolch, 2009; Gobster, 2002; Jun et al., 2009; Shinew et al., 2004; Shores et al., 2007; Stodolska & Yi-Kook, 2005; Zanon et al., 2013).

### *Spatial analyses of park and recreation concepts*

Traditional recreation and leisure research had seldom examined spatial attributes of social psychological concepts, such as constraints, across a landscape (Beeco & Brown, 2013; Jackson, 1994; Miller, Vaske, Squires, Olson, & Roberts, 2017). Mapping and spatial analysis of social science data using GIS, however, have started becoming more popular in recreation research. Aswani and Lauer (2006) suggested that "spatio-temporal, multidimensional GIS, and remote sensing data can serve to verify, explain, or reveal site-specific or regional patterns of human demographic, political, economic, socio-cultural, and ecological dynamics that may not be obvious to researchers on the ground" (p. 81). For parks and other recreation areas, recent spatial analyses of visitor values, conflicts, use levels, and other cognitions and behaviors have helped to more efficiently target locations for managerial responses to issues such as visitor dissatisfaction, ecological degradation, and other impacts (D'Antonio et al., 2010; D'Antonio & Monz, 2016; Hallo et al., 2012; Kidd et al., 2015; Miller et al., 2017; van Riper & Kyle,

2014; van Riper, Kyle, Sutton, Barnes, & Sherrouse, 2012; Wolf, Brown, & Wohlfart, 2018).

Few studies, however, have explicitly examined spatial distributions of constraints across a landscape using approaches such as GIS. Studies that have examined spatial aspects of constraints mainly focused on residential distance from recreation sites as a primary constraint on visitation (Jackson, 1994; Tarrant & Cordell, 1999; Tarrant & Porter, 2005) and differences in constraints among residents of broad geographical locations such as rural and urban areas (Ghimire, Green, Poudyal, & Cordell, 2014; Johnson, Bowker, & Cordell, 2001; Wilhelm Stanis, Schneider, Shinew, Chavez, & Vogel, 2009). For all parks, including urban parks, residential location and distance can be constraining factors that inhibit visitation (Jackson, 2005). Studies have shown, however, that these factors alone are often not the most prevalent constraints faced by visitors; distance, location, and transportation constraints are often dwarfed by lack of time, costs of visiting (e.g., park fees), safety, and other concerns (e.g., Byrne & Wolch, 2009; Gobster, 2002; Hultsman, 1995; Tarrant & Cordell, 1999; Tarrant & Porter, 2005).

### *Research questions*

This article expands on the more conventional approach of using survey research to study constraints by also analyzing these constraints spatially using GIS. This spatial analysis provides a geographic and visual representation of locations where constraints are more or less prevalent. Understanding this geographic distribution of constraints is important because it may enable targeting of areas where park management and outreach efforts are necessary and where they are not, which can improve efficiency of resource allocation.

This article examined three research questions associated with resident constraints to visiting urban parks in the Portland metropolitan region. First, what are the constraints to urban park visitation in this region (i.e., dimensions of constraints) and can residents be grouped according to these constraints (i.e., constraint groups)? Second, are there identifiable spatial or geographic clusters of: (a) white majority residents and racial and ethnic minorities, (b) constraint groups, and (c) different types (i.e., dimensions) of constraints? Third, are there locations where the geographic clusters of these characteristics and constraints overlap? This type of spatial analysis (i.e., GIS) of constraints and resident characteristics expands on past studies that primarily focused on location (e.g., rural, urban) and distance from recreation areas.

## Methods

### *Study region*

Data were obtained from residents of Clackamas, Multnomah, and Washington counties, which collectively make up the Portland metropolitan region. These counties are the largest by population in Oregon. Portland is known for its parks and green spaces, and 17% of its acreage is park land (Harnik, Martin, & Barnhart, 2015). Many agencies manage parks in this area, such as Metro, Tualatin Hills Park and Recreation District, Portland Parks and Recreation, and the cities of Gresham, Lake Oswego, and Oregon

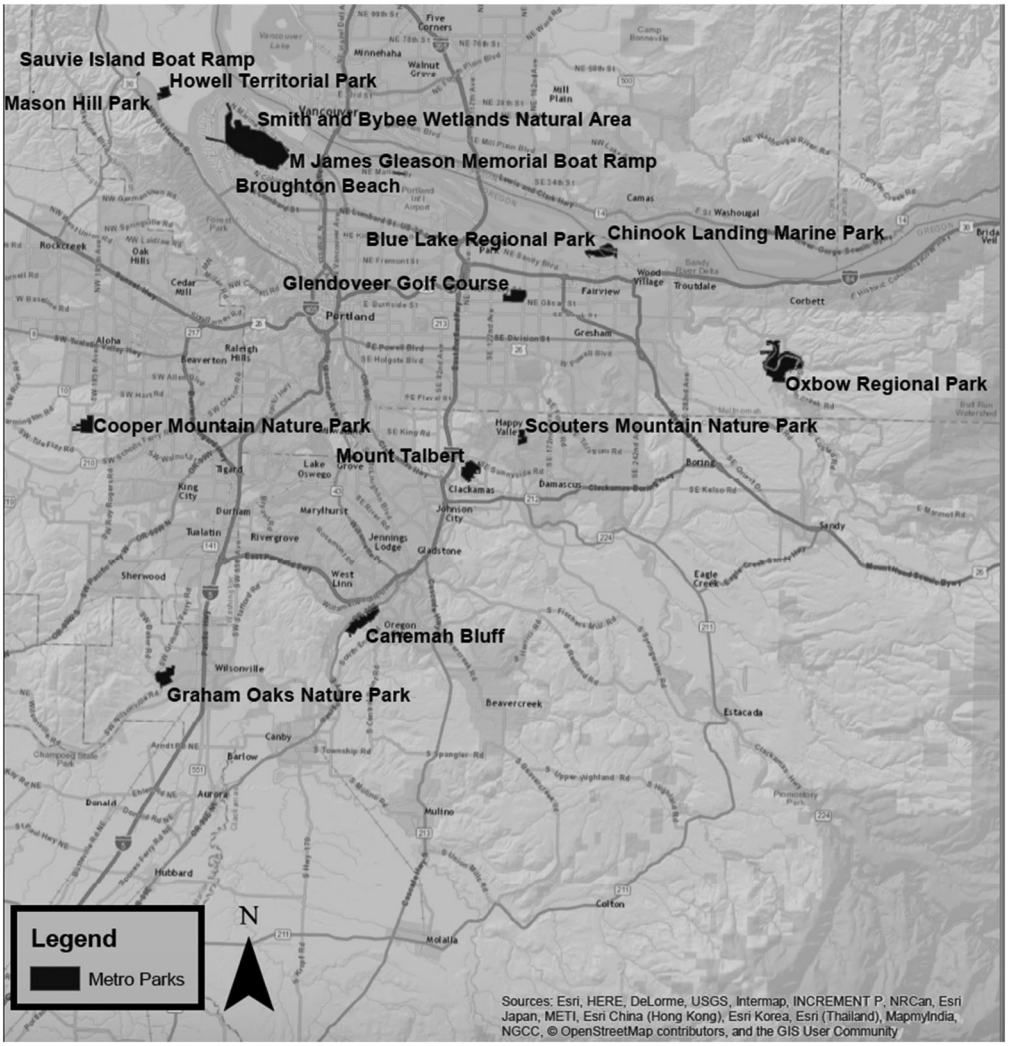


**Figure 1.** Map of the Portland metropolitan area and Metro parks examined.

City. This study focused on parks and natural areas in the Portland region in general, as well as those managed by Metro in particular. As the regional government for Clackamas, Multnomah, and Washington counties, Metro manages approximately 17,000 acres of land. This study examined all 15 areas managed by Metro at the time of this study and they include a range of development and naturalness (12 urban parks and natural areas, two boat ramps, one golf course and trail area; Figure 1).

## *Data collection*

A mixed-mode questionnaire (mail, internet) was sent to a stratified random sample of households from November 2016 to January 2017 asking for one resident of each household who is over the age of 18 to complete the questionnaire. This sample was drawn randomly from the most current representative address-based system (ABS)

combined with other databases (e.g., last name algorithms, ethnicity codes, census block clusters largely consisting of minorities) to oversample the following six groups and ensure a large enough sample of racial and ethnic minority populations: African Americans/blacks, American Indians, Asians, Hispanics/Latinos, Middle Eastern peoples, and Slavic/Eastern European peoples. These groups were identified based on consultation with Metro. In the analyses, these racial and ethnic minority subpopulations were combined into a single stratum, as project scope and funding limited the ability to collect large enough samples of each subpopulation to be representative of each on its own. The sample also included white majority residents as a second stratum.

Questionnaires were administered using four mailings (Dillman, Smyth, & Christian, 2014; Vaske, 2008). The first mailing consisted of a letter explaining the purpose of the study and an invitation to complete the questionnaire on the internet using an individual access code provided with the letter. Two weeks later, the second mailing consisted of a letter, paper (printed) questionnaire, and postage paid reply envelope. One week later, the third mailing was a postcard reminder to complete the paper or internet questionnaire. Three weeks later, a fourth mailing consisted of a letter, paper questionnaire, and postage paid reply envelope. Both the internet and paper (mail) versions of the questionnaire were available in English, Latin American Spanish, Russian, Traditional Chinese, and Vietnamese.[1] These are the five most frequently spoken languages in the Portland region and were selected in partnership with Metro.

Questionnaires were sent to 4,250 residents with 620 completed and returned (15% response rate after accounting for undeliverables [moved, vacant]). There were 316 white majority and 235 racial and ethnic minority respondents (69 were excluded because they did not answer the race/ethnicity questions). A telephone non-response bias check ($n = 137$) was administered to nonrespondents to determine any potential differences between nonrespondents and respondents. This nonresponse bias check contained 12 questions from the questionnaire (e.g., 4 measuring constraints, 5 measuring demographics including race) and no substantive differences were found. More details about the questions and results of this nonresponse bias check are reported in Needham and Rushing (2017). The sample was, however, weighted by census data based on county, age, sex (male, female), and education to be more representative of the study region. Race and other demographics were consistent with the census after weighting.

### Analysis variables

Thirty-seven constraints were measured in the questionnaire. These items are listed in Tables 1 and 2, consistent with many used in the literature (e.g., Hubbard & Mannell, 2001; Jackson, Crawford, & Godbey, 1993; Metcalf, Graefe, Trauntvein, & Burns, 2015; Stodolska & Yi-Kook, 2005), and reflective of possible constraints unique to the Portland region and Metro parks. These questions measured 19 constraints to visiting urban parks and natural areas in the Portland region in general (including Metro parks), and 18 constraints to visiting just Metro parks in particular. The constraint

[1]Studies (Guo & Schneider, 2015; Walker, Jackson, & Deng, 2007) have found differences among races, ethnicities, and languages in responses to variables measuring constraints. In this study, however, more than 95% of respondents chose to answer the English questionnaire.

items were measured on a 4-point scale from 1 "strongly disagree" to 4 "strongly agree" that it "makes it difficult for you or your family to visit." [2]

The questionnaire also measured racial and ethnic identity. Respondents were considered a racial or ethnic minority if they selected any response other than "White/Caucasian" (from the groups listed above – African American/black, American Indian, Asian, Hispanic/Latino) and/or considered themselves to be Slavic (from Russia, Belarus, Ukraine, Poland, Serbia, Slovakia, Croatia, Czech Republic, Slovenia, Bosnia/Herzegovina, Montenegro, Macedonia, or Bulgaria) or Middle Eastern (from Egypt, Iran, Turkey, Iraq, Saudi Arabia, Yemen, Syria, Oman, United Arab Emirates, Jordan, Palestine, Israel, Lebanon, Kuwait, Qatar, Bahrain, or Cyprus). Those who selected only "White/Caucasian" and did not also select any other response or consider themselves to be Slavic or Middle Eastern were considered to be a white majority resident.

Residential locations were determined using geographic point-location data included as part of the information in the sample (e.g., each household had a precise latitude and longitude associated with the address provided in the ABS sample). These X and Y coordinates provided a spatial tag for residential location that was used in spatial analyses to determine if race/ethnicity and constraints varied geographically across the region.

## Data analysis

### Factor, reliability, and cluster analyses

Principal components exploratory factor analysis (EFA) with varimax rotation reduced the constraint items into types or factors (hereafter called dimensions of constraints). EFA was chosen in lieu of confirmatory factor analysis (CFA) because although the literature has often grouped constraints into only three broad categories (intrapersonal, interpersonal, structural), this research explored a more nuanced examination of possible additional dimensions consistent with recommendations of recent research (e.g., Kyle & Jun, 2015; Stodolska et al., 2019). EFAs were run first for constraints associated with visiting urban parks and natural areas in the Portland region in general, and then for other constraints associated with visiting just Metro parks in particular. Reliability of these multi-item dimensions was measured with Cronbach's alpha. An alpha coefficient of approximately .60 to .65 or greater coupled with factor loadings exceeding .40 suggest that multiple variables are measuring the same factor and justify combining them into an index (Tabachnick & Fidell, 2018; Vaske, 2008). K-means cluster analysis was then used for grouping participants based on these constraint dimensions (hereafter called constraint groups). These analyses were run in SPSS 25.0 software.

### Spatial analyses

Results of these analyses were then examined spatially to determine any patterns in racial/ethnic clustering, constraint groups, and dimensions of constraints, and if there

[2]Although "neither" or "neutral" midpoint options are commonly included in these types of bipolar scales, they were not included here based on recommendations of recent research showing that large proportions of respondents can be confused by these options, leading to inaccurate responses that affect response distributions (e.g., Sturgis, Roberts, & Smith, 2014).

were any relationships (i.e., overlap) among these patterns. The survey data were linked to residence point locations (X and Y coordinates for each address) for spatial analysis in ArcMap 10.5 software. Maps were created to show spatial distributions of residents (minority, white majority), constraint groups, and dimensions of constraints across the region. A hot spot analysis was performed to examine patterns of these phenomena and identify statistically significant locations where either high values (hot spots) or low values (cold spots) cluster (i.e., if people in similar locations perceive similar constraints, these will cluster into hot spots of constraints). Hot spot analysis uses the Getis-Ord Gi* statistic, producing a *z*-score and associated *p*-value, to determine the statistical significance of point clusters (Getis & Ord, 1992; Mitchell, 2005; Ord & Getis, 1995). The analysis produces a map of the *z*-scores and bins them into confidence intervals.

The racial/ethnic clustering, constraint groups, and dimensions of constraints hot spot analyses were interpolated, using a kriging procedure in ArcMap, to predict unknown hot and cold spot significance levels across the study area. Kriging is a geostatistical procedure that generates an estimated surface based on measured data points and spatial autocorrelation (Burrough, 1986; Oliver & Webster, 1990). Spatial autocorrelation is the assumption that phenomena correlate based on location where areas closer to each other will exhibit similar phenomena (Burrough, 1986). The hot spot and krig interpolations are visualized as a heat map where statistically significant clusters of racial and ethnic minorities, most constrained residents, and high constraints scores are represented on the maps as dark gray or black. Significant clusters of white majority residents, least constrained residents, and low constraints scores are shown in white. Areas that do not have any statistically significant clustering appear in medium gray.

The kriging interpolations from the hot spot analyses of racial/ethnic clustering, constraint groups, and dimensions of constraints that were found to vary spatially were converted from raster to polygon data using the "raster to polygon tool" in ArcMap. The "reclassify tool" was used for assigning a code, ranging from 1 to 9, to the new polygons where minority residents, higher constraint groups, and higher constraints scores for each dimension were assigned higher values. The four polygon layers were combined with the "intersect tool" to visualize where areas with high and low values overlapped meaningfully.

## Results

### *Factor, reliability, and cluster results*

An EFA reduced the 19 constraints associated with visiting urban parks and natural areas in the Portland region in general down to seven factors or dimensions and all factor loadings (.58-.87) exceeded .40 (Table 1). No variables cross-loaded on multiple factors. Factor 1 contained five variables related to racial and cultural issues in parks in the region in general (e.g., "parks or natural areas in the Portland region do not have enough visitors representing my racial, ethnic, or cultural group"). Factor 2 contained five variables associated with fear in these parks (e.g., "I do not feel safe going to parks or natural areas in the Portland region"). Factor 3 contained three variables related to health (e.g., "poor health or physical limitations make it difficult for me to visit parks

**Table 1.** Exploratory factor analysis (EFA) and Cronbach alpha reliability analysis of constraints to visiting all parks and natural areas in the Portland region in general [a].

| Constraint factors (dimensions) and questionnaire items | $M$[b] | $SD$[b] | Item total correlation | Alpha (α) if deleted | Cronbach alpha (α) | Factor Loading | Eigenvalue | Percent (%) variance explained |
|---|---|---|---|---|---|---|---|---|
| Race/cultural issues at all parks in region | | | | | .90 | | 3.59 | 21.13 |
| Based on experience of someone close to me, I fear prejudice from staff or other visitors at parks or natural areas in the Portland region | 1.55 | .62 | .76 | .87 | | .85 | | |
| Based on my own personal experience, I fear prejudice from staff or other visitors at parks or natural areas in the Portland region | 1.54 | .62 | .76 | .87 | | .82 | | |
| Parks or natural areas in the Portland region do not have enough visitors representing my racial, ethnic, or cultural group | 1.77 | .74 | .81 | .86 | | .84 | | |
| Parks or natural areas in the Portland region do not have enough staff representing my racial, ethnic, or cultural group | 1.78 | .77 | .81 | .86 | | .85 | | |
| Information (e.g., staff, signs, programs) at parks or natural areas in the Portland region is often only in English, making it difficult for me to visit | 1.59 | .68 | .62 | .90 | | .60 | | |
| Fear | | | | | .87 | | 3.29 | 19.37 |
| I do not feel safe going to parks or natural areas in the Portland region | 1.85 | .76 | .78 | .82 | | .86 | | |
| I fear crime in parks or natural areas in the Portland region | 2.01 | .81 | .70 | .84 | | .84 | | |
| I am afraid of outdoor places such as parks or natural areas in the Portland region | 1.64 | .65 | .75 | .83 | | .80 | | |
| I tend to avoid parks or natural areas in the Portland region because I am afraid of injury | 1.62 | .64 | .64 | .85 | | .67 | | |
| Parks or natural areas in the Portland region do not feel welcoming to me or my family | 1.65 | .63 | .60 | .86 | | .58 | | |
| Health | | | | | .89 | | 2.59 | 15.22 |
| I have a disability that makes it difficult for me to visit parks or natural areas in the Portland region | 1.64 | .74 | .84 | .80 | | .87 | | |
| Poor health or physical limitations make it difficult for me to visit parks or natural areas in the Portland region | 1.70 | .71 | .79 | .84 | | .87 | | |
| Someone I recreate with is physically unable to visit parks or natural areas in the Portland region | 1.70 | .70 | .73 | .89 | | .74 | | |
| Costs | | | | | .84 | | 1.79 | 10.55 |
| The fees at parks or natural areas in the Portland region are too expensive for me | 2.03 | .77 | .73 | – | | .86 | | |

(*continued*)

**Table 1.** Continued.

| Constraint factors (dimensions) and questionnaire items | $M^b$ | $SD^b$ | Item total correlation | Alpha ($\alpha$) if deleted | Cronbach alpha ($\alpha$) | Factor Loading | Eigenvalue | Percent (%) variance explained |
|---|---|---|---|---|---|---|---|---|
| It is too expensive for me to travel to parks or natural areas in the Portland region | 1.91 | .72 | .73 | – | | .78 | | |
| No interested partners | | | | | .77 | | 1.67 | 9.84 |
| My partner or family is not interested in visiting parks or natural areas in the Portland region | 1.98 | .81 | .62 | – | | .85 | | |
| I do not have anyone to visit parks or natural areas in the Portland region with | 1.86 | .76 | .62 | – | | .74 | | |

[a]Cumulative percentage of variance = 76.11%. Two additional factors each consisted of single variables ("I am not interested in visiting parks or natural areas in the Portland region" [M = 1.92, SD = .83], "I am too busy or do not have enough free time to visit parks or natural areas in the Portland region" [M = 2.54, SD = .81]).
[b]Variables measured on 4-point scale of 1 "strongly disagree" to 4 "strongly agree."

or natural areas in the Portland region"). Factor 4 had two variables about costs of visiting these parks (e.g., "the fees at parks or natural areas in the Portland region are too expensive for me"). Factor 5 contained two variables related to lack of interested recreation partners (e.g., "I do not have anyone to visit parks or natural areas in the Portland region with"). The remaining two factors each consisted of single variables (i.e., loaded on their own factors) and were retained because they represented constraints that have been identified frequently in the literature (see Manning, 2011; Stodolska et al., 2019 for reviews) and were also among the most important constraints for respondents (Rushing, Needham, D'Antonio, & Metcalf, 2019): (a) "I am too busy or do not have enough free time to visit parks or natural areas in the Portland region" (i.e., too busy; $M = 2.54$, $SD = .81$), and (b) "I am not interested in visiting parks or natural areas in the Portland region" (i.e., disinterest; $M = 1.92$, $SD = .83$).

A second EFA reduced the 18 constraints associated with visiting Metro parks in particular down to five other factors and all loadings (.52-.90) exceeded .40 (Table 2). No variables cross-loaded. The first factor had three variables related to racial and cultural issues specific to Metro parks (e.g., "Metro parks do not have programs for people in my racial, ethnic, or cultural group"). The second factor consisted of five items related to Metro parks not being the best places for recreation (e.g., "Metro parks are not the best places for the activities I enjoy doing"). The third factor had three variables regarding limited knowledge about Metro parks (e.g., "before receiving this survey, I did not know where Metro parks were located"). The fourth factor had three items related to lack of facilities and services at Metro parks (e.g., "there are not enough developed facilities/services such as picnic tables, barbeques, picnic shelters, or restrooms"). The fifth factor included two items associated with limited access to Metro parks (e.g., "visiting Metro parks is hard for me because they take too long to get to or are too far away"). Two constraints ("Metro parks are not natural enough [there is too much development now]," "I cannot take pets [e.g., dogs] to Metro parks") did not load on any

**Table 2.** Exploratory factor analysis (EFA) and Cronbach alpha reliability analysis of constraints to visiting Metro parks in particular[a].

| Constraint factors (dimensions) and questionnaire items | *M*[b] | *SD*[b] | Item total correlation | Alpha (α) if deleted | Cronbach alpha (α) | Factor loading | Eigenvalue | Percent (%) variance explained |
|---|---|---|---|---|---|---|---|---|
| Race/cultural issues at Metro parks | | | | | .94 | | 2.94 | 18.38 |
| Metro parks do not have enough visitors representing my racial, ethnic, or cultural group | 1.86 | .67 | .88 | .89 | | .90 | | |
| Metro parks do not have enough staff representing my racial, ethnic, or cultural group | 1.92 | .73 | .86 | .91 | | .90 | | |
| Metro parks do not have programs for people in my racial, ethnic, or cultural group | 1.97 | .80 | .85 | .92 | | .89 | | |
| Metro parks are not the best places | | | | | .72 | | 2.05 | 12.84 |
| Metro parks are not the best places for the activities I enjoy doing | 2.16 | .74 | .50 | .67 | | .77 | | |
| The activities I enjoy doing are not available in Metro parks | 2.20 | .70 | .46 | .68 | | .53 | | |
| Metro parks do not feel welcoming to me or my family | 1.85 | .57 | .63 | .62 | | .68 | | |
| Metro parks have too many rules/ regulations | 2.10 | .62 | .49 | .67 | | .65 | | |
| I tend to avoid Metro parks because they are too crowded | 2.14 | .69 | .34 | .72 | | .66 | | |
| Limited knowledge about Metro parks | | | | | .77 | | 2.30 | 14.40 |
| Before receiving this survey, I did not know where Metro parks were located | 2.91 | .91 | .61 | .69 | | .82 | | |
| I do not know where to get information about Metro parks | 2.56 | .86 | .61 | .69 | | .79 | | |
| I do know enough about what I can do at Metro parks | 2.83 | .82 | .60 | .70 | | .76 | | |
| Lack of Metro facilities/services | | | | | .70 | | 2.17 | 13.57 |
| There are not enough developed facilities/services at Metro parks (e.g., picnic tables, barbeques, picnic shelters, restrooms) | 2.39 | .66 | .55 | .57 | | .79 | | |
| Metro parks do not provide online reservations of picnic areas/shelters | 2.29 | .72 | .53 | .60 | | .72 | | |
| Facilities at Metro parks are difficult to access for people with disabilities/ mobility issues | 2.26 | .64 | .48 | .66 | | .52 | | |
| Limited access to Metro parks | | | | | .54 | | 1.33 | 8.29 |
| There is no public transportation (e.g., buses) to the Metro parks I want to visit | 2.33 | .76 | .36 | – | | .86 | | |
| Visiting Metro parks is hard for me because they take too long to get to or are too far away | 2.54 | .85 | .36 | – | | .52 | | |

[a]Cumulative percentage of variance = 67.48%. Two additional items ("Metro parks are not natural enough [there is too much development now] [M = 2.15, SD = .61];". "I cannot take pets [e.g., dogs] to Metro parks" [M = 2.21, SD = .92]) did not load on any factor, so were eliminated from further analyses.
[b]Variables measured on 4-point scale of 1 "strongly disagree" to 4 "strongly agree."

factor and were among the least important for respondents (Needham & Rushing, 2017), so they were eliminated.

Alpha coefficients indicated internal consistency for these multi-item dimensions of constraints associated with visiting: (a) urban parks and natural areas in the Portland region in general ("race/cultural issues at all parks in region" = .90, "fear" = .87,

"health" = .89, "costs" = .84, "no interested partners" = .77; Table 1), and (b) Metro parks in particular ("race/cultural issues at Metro parks" = .94, "Metro parks are not the best places" = .72, "limited knowledge about Metro parks" = .77, "lack of Metro park facilities/services" = .70, "limited access to Metro parks" = .54; Table 2). The coefficient for "limited access to Metro parks" (.54) did not meet the recommendation of .60 to .65 or greater, but this factor only included two variables that consistently loaded together, face validity was apparent (e.g., "there is no public transportation to the Metro parks I want to visit," "visiting Metro parks is hard for me because they take too long to get to or are too far away"), the factor loadings exceeded .40 (.52, .86), and both this ($M = 2.33$–$2.54$, $SD = .76$–$.85$) and other studies have shown access and transportation to be important constraints (e.g., Stodolska et al., 2019). Deletion of any variables from their respective factor or dimension did not improve reliability.

K-means cluster analysis grouped respondents based on how constrained they felt across all 12 of these constraints dimensions. Separate cluster analyses were run to generate two, three, four, five, and six group solutions. The three group solution provided the best fit for the data with a clear pattern among the three distinct clusters emerging. Those who reported the lowest mean scores for all 12 dimensions of constraints were considered "least constrained." The "most constrained" group had the highest mean scores for all dimensions. Those who fell in between these groups for all dimensions were considered "moderately constrained." The largest proportion of residents was in the moderately constrained group (48%), the second largest was in the least constrained group (33%), and the smallest was in the most constrained group (19%).

Two analyses validated and confirmed the stability of this cluster solution. First, the data were randomly sorted and cluster analysis was conducted after each of four sorts. These analyses supported the solution identifying three groups based on their constraints. Second, discriminant function analysis determined how well all of the original constraint variables predicted these three groups generated from the 12 factors. All of the original variables significantly predicted the groups, Wilks' lambda $U = .548$ – $.932$, $F = 10.57$ – $118.71$, $p < .001$. These variables correctly classified 95% of residents in the least constrained group, 96% in the moderately constrained group, and 91% in the most constrained group. In total, 95% of residents were correctly classified. These results supported the validity and stability of this three group solution.

## Spatial results

The hot spot analysis followed by krig interpolation produced a heat map revealing the spatial clustering of residential locations of both white majority and racial and ethnic minority respondents across the region (Figure 2). Minorities were given a value of 1 and white majority residents had a value of 0. Minorities tended to cluster in the northeast of the region, whereas white majority respondents clustered more in the southern and southwestern areas of the region. Similarly, a hot spot analysis of the three constraint groups (least, moderate, most) revealed that the most constrained respondents also clustered significantly more in the northeast of the region, whereas the least constrained clustered significantly more in the south and southwest (Figure 3). Areas with

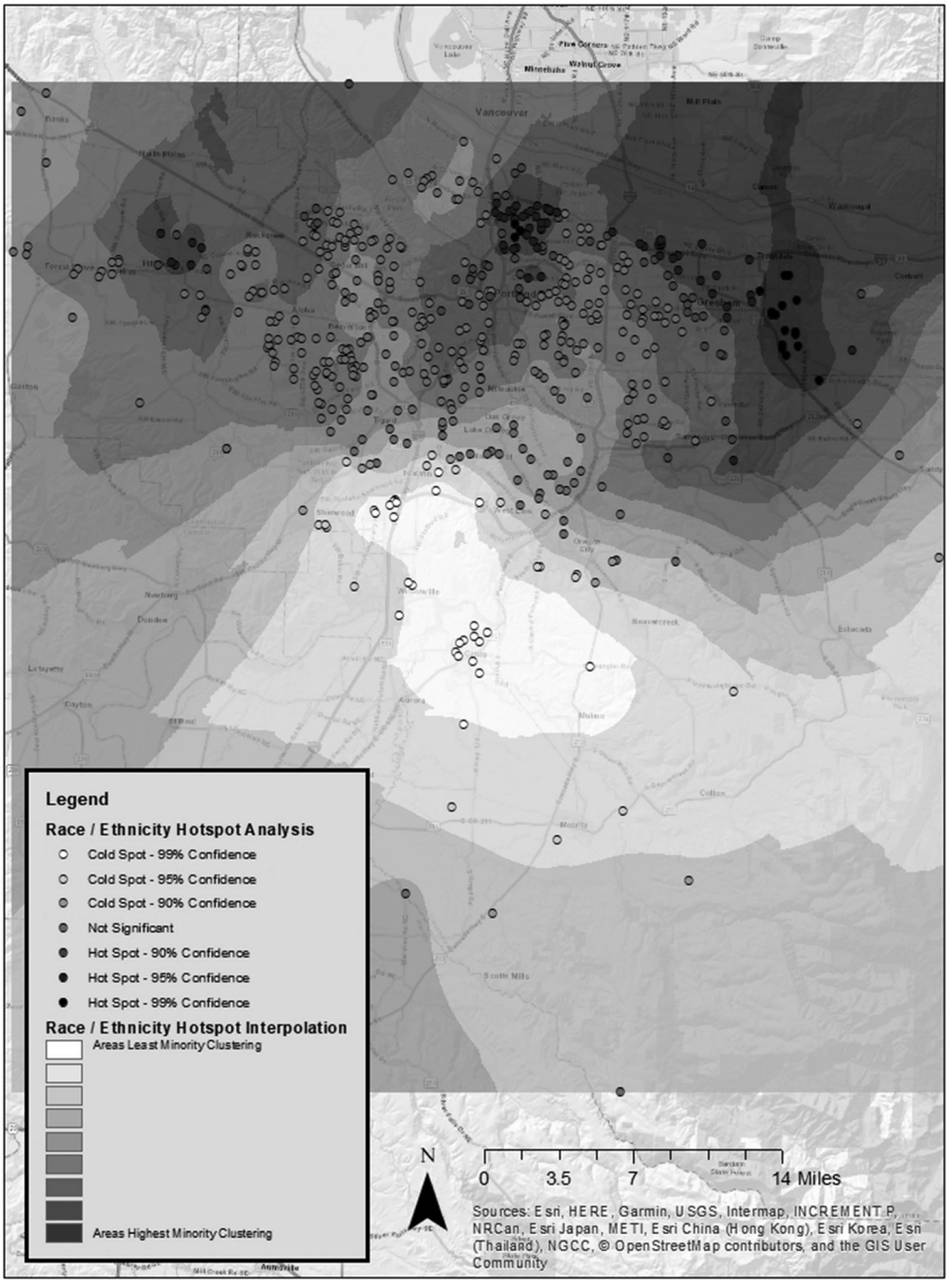


**Figure 2.** Hot spot analysis and krig of racial/ethnic minority residential locations.

concentrations of higher values appear on the maps as dark gray or black (clusters of minority or most constrained residents), and areas with concentrations of lower values appear in white (clusters of white majority or least constrained residents).

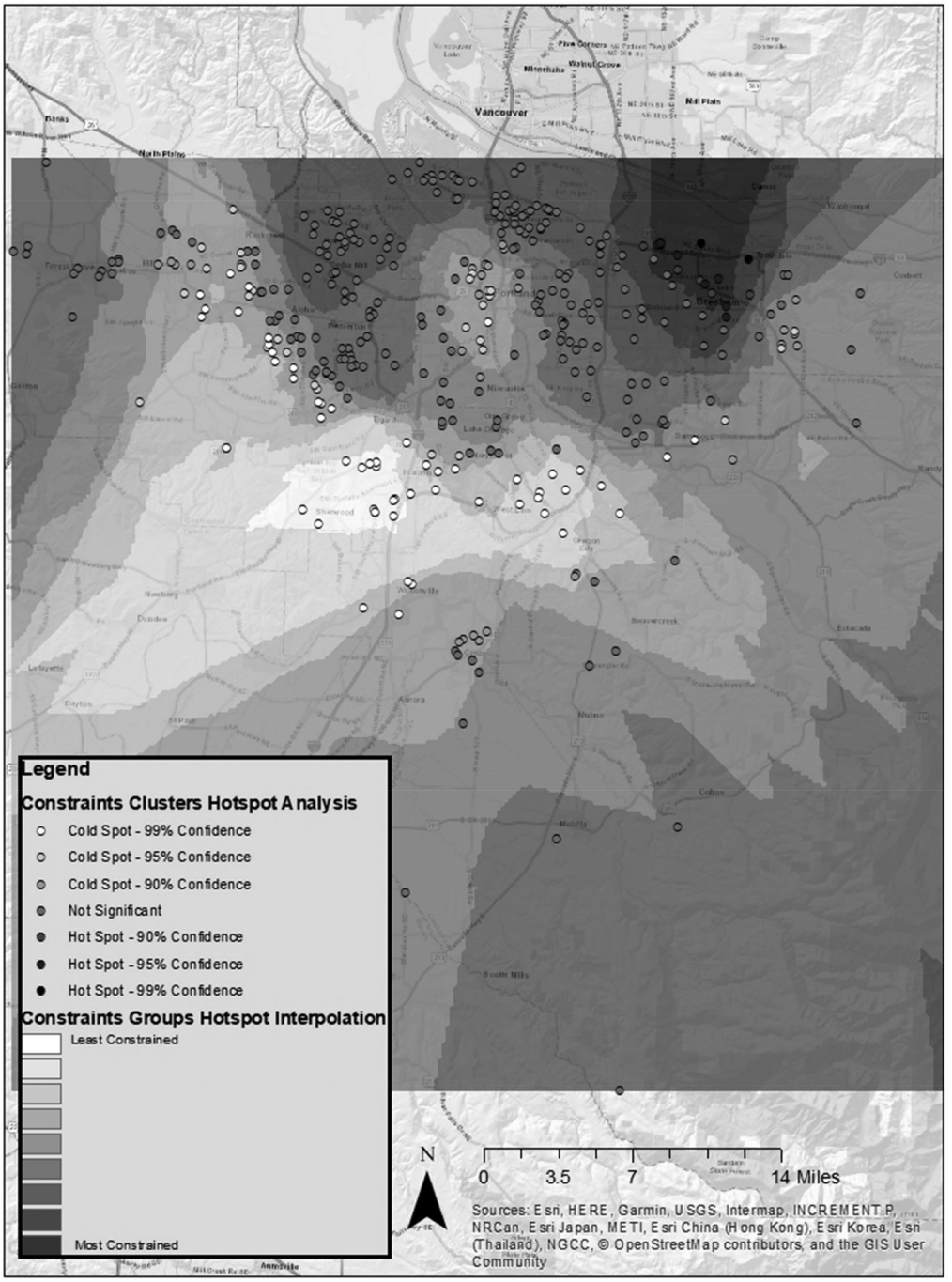


**Figure 3.** Hot spot analysis and krig of constraint group residential locations.

Hot spot analyses were then run for each of the dimensions of constraints to determine if there were any spatial patterns. Four of the 12 dimensions had clear evidence of spatial clustering (health, no interested partners, limited of knowledge about Metro parks, limited access to Metro parks), whereas the remaining eight dimensions did not.

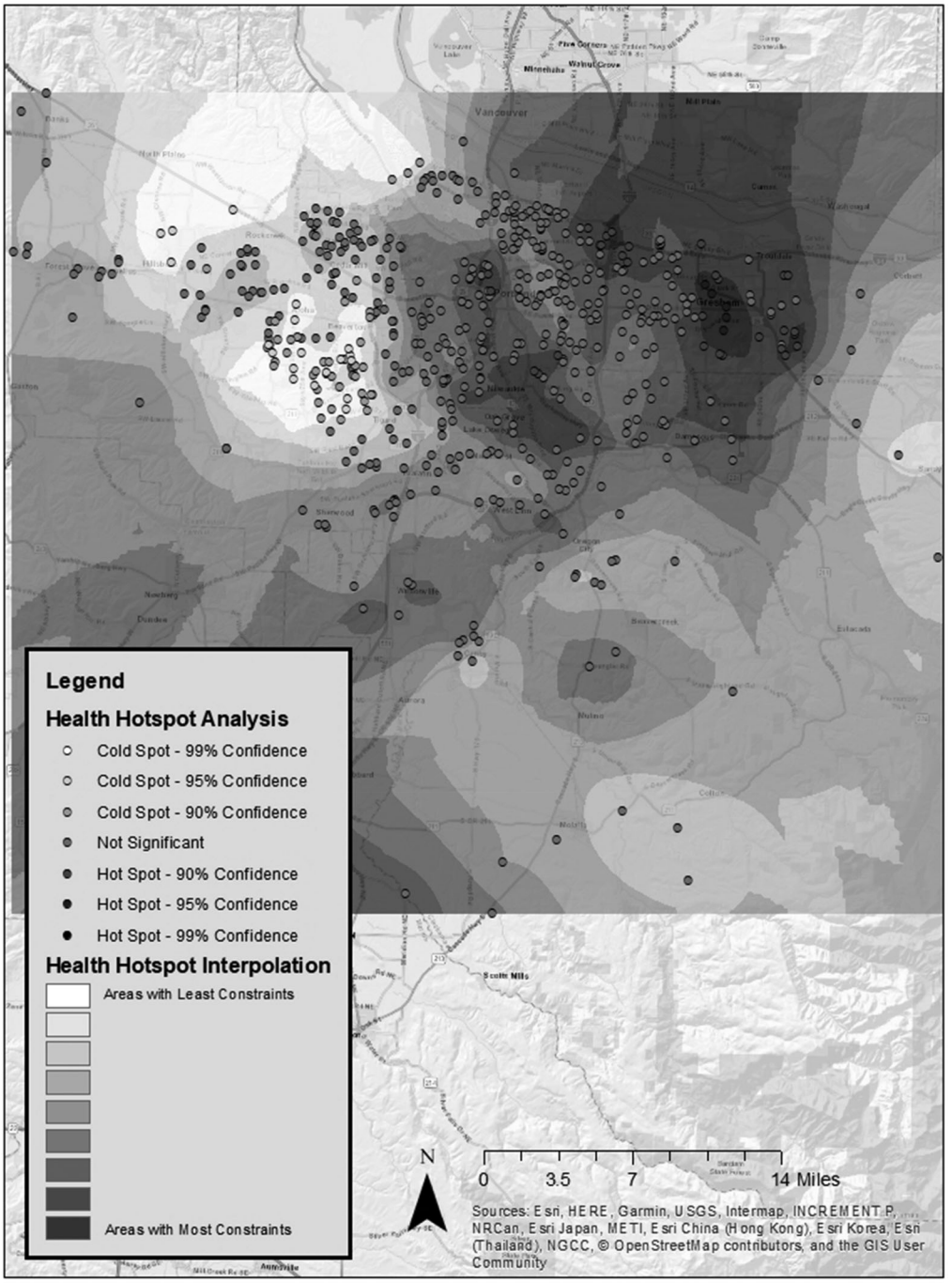


**Figure 4.** Hot spot analysis and krig of areas where residents are constrained by health issues.

This suggests that although there were identifiable spatial or geographic clusters of areas dominated by some constraints, there was only a partial relationship between constraints dimensions and geographic areas because two-thirds of the constraints dimensions examined here were not spatially clustered. Respondents living in the northeast of

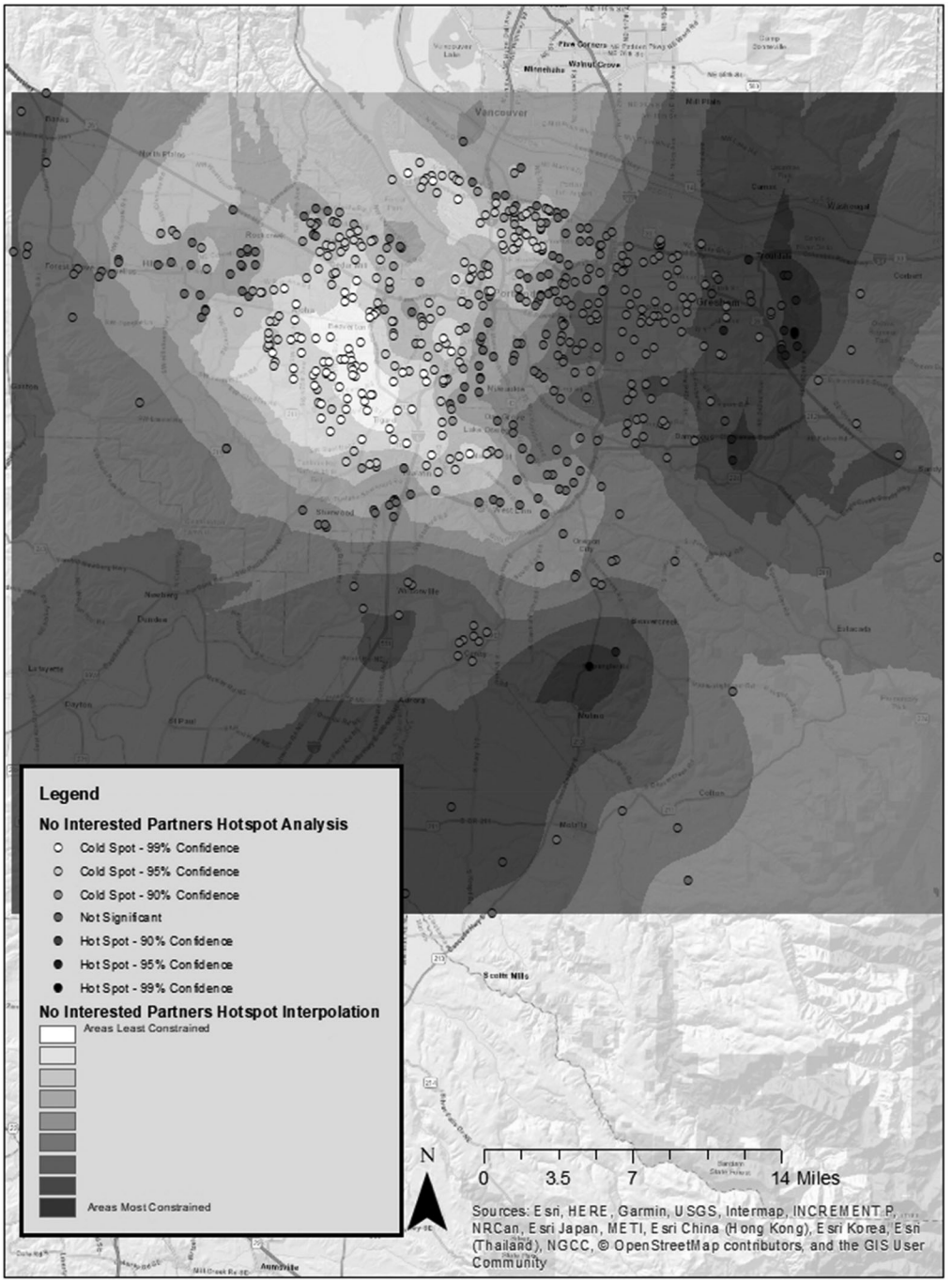


**Figure 5.** Hot spot analysis and krig of areas where residents are constrained by lack of interested partners.

the region were significantly more constrained by health issues (Figure 4) and lack of interested partners (Figure 5), whereas those living in the west and northwest were significantly less constrained by these issues. A small hot spot for the lack of interested

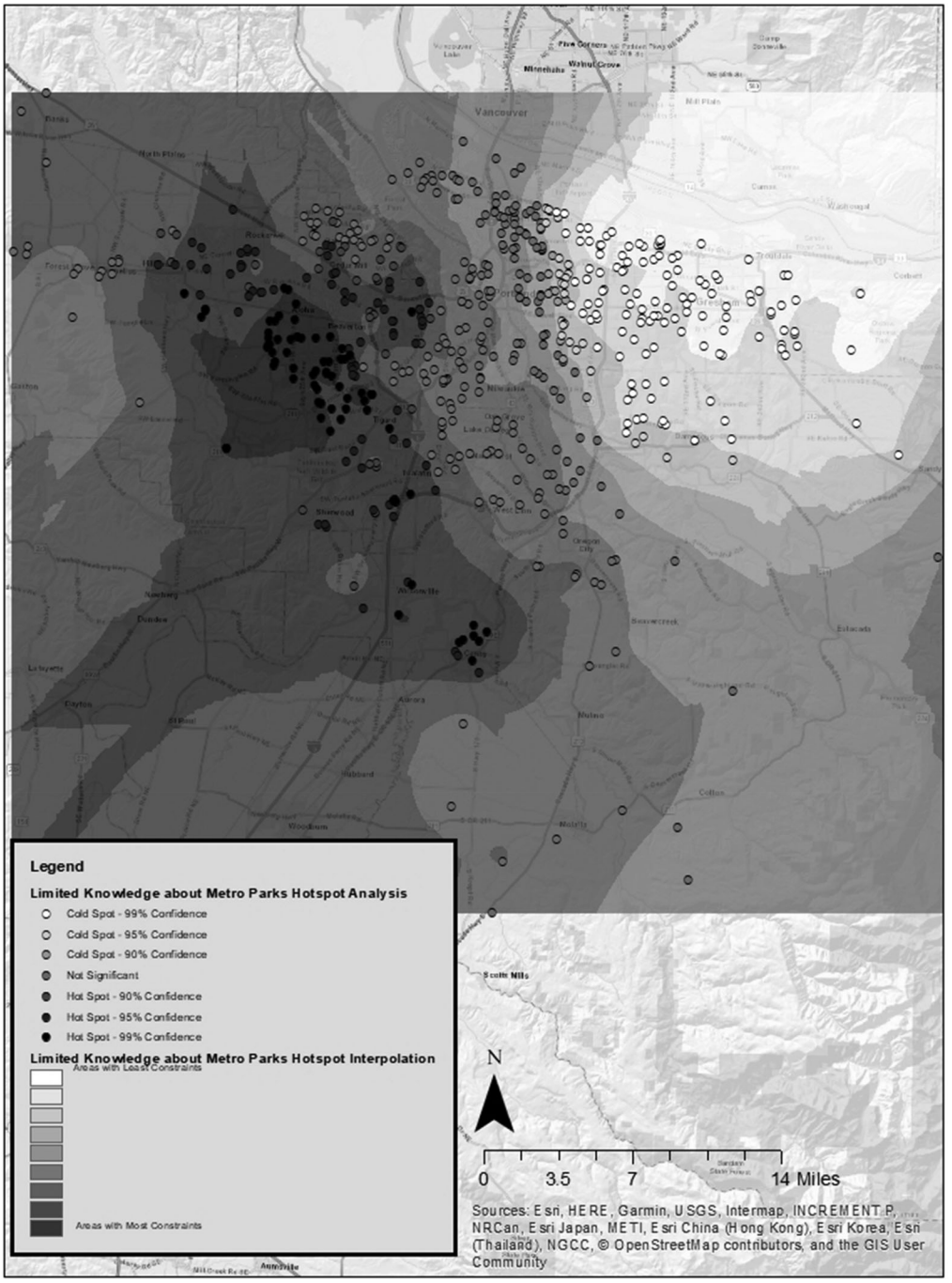


**Figure 6.** Hot spot analysis and krig of areas where residents are constrained by limited knowledge about Metro parks.

partners dimension also appeared in the south-central area of the region, but that seems to be centered around a single resident, so may not represent any regional trends. Conversely, respondents in the western and southwestern parts of the region were

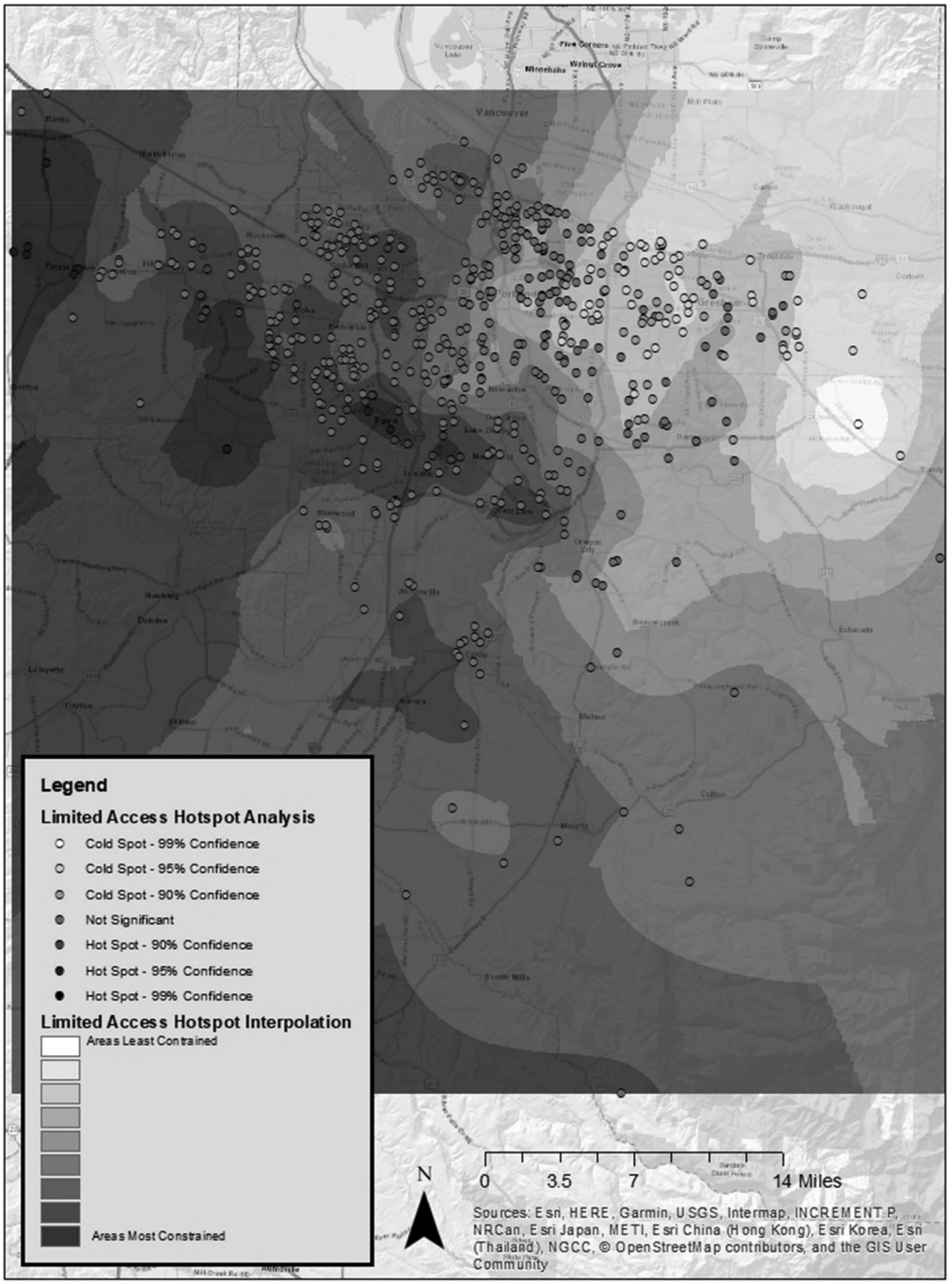


**Figure 7.** Hot spot analysis and krig of areas where residents are constrained by limited access to Metro parks.

significantly more constrained by both limited knowledge about Metro parks (Figure 6) and limited access to these parks (Figure 7), whereas those in the east and northeast were significantly less constrained by these dimensions.

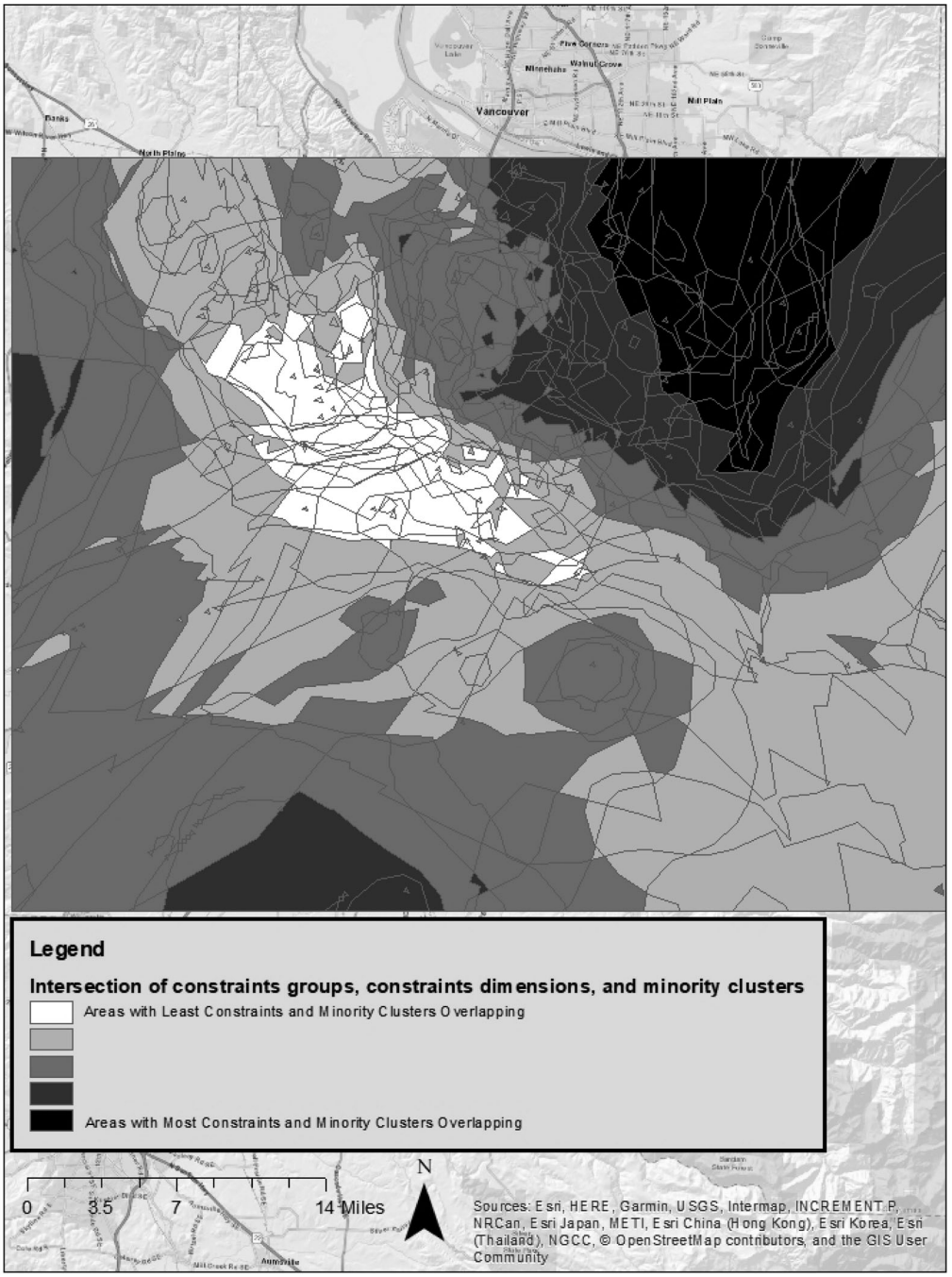


**Figure 8.** Intersection of constraint groups, dimensions of constraints, and minority clusters.

Results from the intersect analysis revealed some overlap of the constraint groups and these dimensions of constraints that had clear evidence of spatial clustering with areas of high racial and ethnic minority clustering. The northeast area of the region had

significantly higher clustering of racial and ethnic minorities, most constrained residents overall, and residents constrained by health and no interested partners (Figure 8).

## Discussion

This study was conducted partly in response to Jackson's (1994) call to integrate the fields of constraints and geography given the limited research examining spatial attributes of constraints to recreation. This research is methodologically novel in that it analyzes social science survey data in a spatial fashion using GIS to examine the distribution of constraints across an urban area. Results revealed two major trends in the Portland metropolitan region: (a) there was a clustering of minority residents overlapping with the most constrained hot spots in the northeast area of this region, with these residents most affected by constraints associated with health and lack of partners interested in recreation; and (b) those in the west and southwest areas of this region were more likely to be white majority residents and most affected by constraints associated with limited knowledge about parks and access to these areas. This methodology is replicable and these results have implications for both management and research.

### *Management implications*

From a management perspective, the interpolated maps generated from the hot spot analyses provide visual representations of residential race/ethnicity distributions and constrained communities in the Portland region. These findings can help managers understand where high densities of certain populations (e.g., minorities) reside, what areas and groups are most impacted by constraints, and whether communities in these locations face specific types (i.e., dimensions) of constraints. With these visualizations, managers can follow a more directed and efficient approach to community outreach, marketing, and efforts to alleviate constraints.

Results showed that many minority residents clustered in the northeast area of the region. Managers with goals of recruiting and retaining more racial and ethnic minorities in recreation participation may consider directing outreach to minority-dense locations such as this area. Outreach efforts may include contacting community leaders and hubs (e.g., markets, community organizations, churches) that should be culturally relevant and appropriate (Stodolska & Yi-Kook, 2005). Once these efforts have been started or expanded, managers can learn how to make parks feel more welcoming for diverse groups. In addition to reaching minority communities, it is imperative that managers address specific constraints these residents face to best serve the population. Residents in the northeast of this region are not only more constrained by health and lack of interested partners, but they are also the most constrained population in the entire region overall. Managers should strive to understand how to alleviate constraints for this community, such as providing more ADA accessibility and other facilities for people with health constraints, and programing for residents to meet new recreation partners (Scott & Jackson, 1996).

Hot spots of residents constrained by lack of knowledge about Metro parks and lack of access to these parks appeared in the western and southwestern areas of the region.

There are fewer Metro parks in the west and southwest areas than in other parts of this region, so it would be expected that residents of these areas would know less about these parks and feel more constrained by distance and access. A notable finding, however, is that there is one Metro park located in the center of a hot spot for limited knowledge about Metro parks, which suggests that managers should improve marketing of parks in this community given that some of its residents are currently unaware there is a Metro park in their neighborhood. To address constraints associated with limited knowledge and access to parks in the west and southwest parts of the region, managers also should consider increasing broader marketing, promotional outreach, and programing in the areas, which tend to be supported by residents in many other areas (e.g., Manning, 2011; Scott & Jackson, 1996). If managers wish to attract more people to their parks, they may also need to work with city planners to expand public transportation bringing residents in the west and southwest of this region to parks in other areas, such as the north and northeast. In addition, if regional managers are in a position to acquire more land for parks and protected areas, they should consider focusing acquisitions on the west and southwest areas. These results can provide managers with a specific starting point for directing constraints relief and representative inclusion efforts across the region they serve.

### *Research implications*

From a research perspective, these findings are consistent with research suggesting that areas with higher minority resident clustering could overlap with areas that have clustering of the most constrained residents. For example, research has shown that demographic factors, such as race and ethnicity, are related to constraints and can work in unison with these constraints, resulting in compounding effects (e.g., Shores et al., 2007; Walker & Virden, 2005). Results here showed that residents in the northeast area of the Portland region were not only more likely to be minorities, but were also more likely to be constrained by health and lack of interested partners. Research has demonstrated that race and ethnicity are sometimes associated with health-related constraints (CDC, 2004; Lowry, Kann, Collins, & Kolbe, 1996; Shores et al., 2007; Taylor, Floyd, Whitt-Glover, & Brooks, 2007). Studies have also shown that racial and ethnic minorities generally prefer to recreate with partners and other familiar people (e.g., families), often in larger groups (e.g., Floyd et al., 1994; Gobster, 2002; Johnson & Monroe, 2008; Manning, 2011). Most of these studies compared white and black/African American respondents, but some other races and ethnicities have been examined (e.g., Asian, Hispanic/Latino). Therefore, the overlapping of areas with higher minority clustering and residents who are more constrained by health issues and a lack of partners interested in recreation are predictable in light of this previous research.

Results also showed that respondents in the west and southwest areas were more likely to be white majority residents and affected by constraints associated with limited knowledge about parks and access to these areas. This is contrary to some studies showing minorities with less access and knowledge regarding parks in some areas (e.g., Gobster, 2002; Metcalf et al., 2013; Shores et al., 2007). Results in the literature, however, are mixed, as there are other studies showing that minority communities may actually have more access to parks, but of lesser quality (e.g., Vaughan et al., 2013). In a

study of Chicago parks, for example, Shinew et al. (2004) found that white respondents perceived more constraints related to access (e.g., transportation) and location than did black/African American respondents. These mixed findings suggest that relationships between constraints and race/ethnicity may be site-specific (Kyle & Jun, 2015).

This study used survey research and GIS to integrate geographical and social psychological research on constraints. Analyses of this kind provide researchers and managers alike with a novel way of understanding constraints, as they can vary spatially across an area. Since Jackson's (1994) call to integrate these fields, however, there has been limited research on how constraints relate to spatial attributes. Research that does exist has largely focused on residential location (e.g., rural, urban) and distance from recreation sites; spatial analysis (e.g., GIS) of additional constraints and the extent they are related to other resident characteristics (e.g., race and ethnicity) have received little attention (Jackson, 1994; Tarrant & Cordell, 1999; Tarrant & Porter, 2005). Results here showed that hot spot analyses of multiple constraints can reveal spatial trends across an urban landscape. The resulting visualizations from these analyses allow researchers to see spatial patterns in constraints and can serve as tools for efficiently directing future research and funding to alleviate relevant constraints for specific communities.

Although the results showed some dimensions of constraints with notable and significant spatial patterns (e.g., health, lack of interested partners, limited knowledge about and access to parks), two-thirds of the constraints examined did not have significant clustering of hot and cold spots (e.g., fear, costs). This study, however, is limited to one geographical area (Portland metropolitan region) and results may not extend to other regions. Future research, therefore, should investigate multiple dimensions of constraints in other locations to examine whether the clustering patterns found and not found here hold true in other locations, or if significant spatial patterns are site-specific. In addition, the sample sizes in this research limited examination of the racial and ethnic minorities to a single combined group. Given that research has shown some differences in constraints among subpopulations of racial and ethnic minorities (e.g., Carlson, Brooks, Brown, & Buchner, 2010; Hudson, Hinch, Walker, & Simpson, 2010; Metcalf et al., 2013; Wilhelm Stanis, Schneider, Chavez, & Shinew, 2009), future studies should spatially examine (e.g., with GIS or other approaches) constraints for various subpopulations.

Almost all quantitative studies of constraints, including this study here, used a *reflective* measurement approach where relationships among responses to multiple questionnaire variables are explained by broader dimensions of constraints (e.g., factors from an EFA; see Godbey, Crawford, & Shen, 2010; Kyle & Jun, 2015 for reviews). Kyle and Jun (2015), however, proposed an alternative *formative* approach where variables are thought to directly "cause" dimensions, citing low factor loadings and poor reliabilities of some reflective studies, especially those using the three dimensional (intrapersonal, interpersonal, structural) hierarchical model of constraints (Crawford & Godbey, 1987). Given concerns about this three dimensional model, the study here explored a more nuanced examination of additional dimensions, some of which were site-specific. The quantitative results (i.e., EFAs) were consistent with recent research by Stodolska et al. (2019) who found similar categories of constraints in their qualitative study (e.g., cost, lack of knowledge about parks and opportunities, access such as transportation, time such as being too busy, programs and facilities, safety concerns, issues related to race and culture). In

addition, unlike the three dimensional model where some dimensions sometimes contain several seemingly unrelated variables (e.g., the structural dimension containing access to transportation, lack of time, crowding in parks, cost of visiting, and information available [Kyle & Jun, 2015]), all variables in each multi-item factor here shared a common theme, all factor loadings (.52–.90, $M = .76$) exceeded .50 suggesting they are "practically significant" (Hair, Anderson, Tatham, & Black, 1988, p. 111), the item total correlations (.34–.88, $M = .65$) indicated that the variables in each factor were correlated, and all reliabilities were high (.70–.94, $M = .82$) except for one factor (access to Metro parks = .54) that was measured with only two variables. Future research should improve measurement of this access dimension and also refine the measurement of constraints by testing and comparing both reflective and formative modeling approaches.

This study found that hot spot analysis of specific constraints, white majority and racial and ethnic minority residents, and constraint groups is a novel way of understanding spatial attributes. Other spatial analysis techniques, such as grouping analysis, optimized hot spot analysis, and cluster and outlier analysis, could have been used, but hot spot analysis was chosen because it tends to be more robust in dealing with potential outliers (Caldas de Castro & Singer, 2006). Future research should expand on these findings using hot spot analysis and other spatial analysis techniques, examine more recreation and leisure concepts that have seldom been analyzed spatially (e.g., norms, motivations, attachment), and continue responding to Jackson's (1994) call for integrating traditional social science research with more contemporary geographic approaches. For example, in addition to examining constraints spatially, it would be interesting to explore any spatial patterns in the negotiation or alleviation of constraints. One advantage of the methodological and analytical approaches used here is they can be applied to any sample or survey that contains geographic point location information (e.g., residence latitude, longitude). Using this information to conduct spatial analyses of constraints and other concepts in the future will improve understanding of park and recreation issues, and how they relate to geographical spaces. This can provide managers with important, accessible material for efficiently addressing constraints and other issues faced by their clientele, thereby creating a more inclusive environment in landscapes they manage.

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