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Social inequalities of park accessibility in Shenzhen, China: The role of park quality, transport modes, and hierarchical socioeconomic characteristics

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ABSTRACT

Identifying the geographic units with restricted access to intra-urban parks has become a hot issue in transport studies. Previous literature has examined the social inequalities of park accessibility under the Western context; however, the issue has seldomly investigated against the non-Western background, especially in China. Using a case of Shenzhen (China), this paper examines the accessibility to parks of three quality levels (official standard) under four transport modes (public transit, walking, bicycle, and private car). In particular, the daily travel time from each community (8117) to each park (625) was harvested from the Baidu Map during 18:30–20:30 in July 2016. We further, based on the travel time calculations, develop four baseline indicators (the weighted average, the minimum, the maximum, and the standard deviation travel time) and three tolerance indicators of park accessibility (weighted average travel time within visit tolerance thresholds, standard deviation travel time within visit tolerance thresholds, and number of parks within visit tolerance thresholds) to measure park accessibility for each community. Results show that the seven accessibility indicators generate different estimations and the quantified accessibility varies greatly with park quality levels and transport modes. Communities present greater variations in accessibility to the first quality level and second quality level parks via walking and public transit. In addition, hierarchical regression is utilized to quantify the relationships between park accessibility and sociodemographic characteristics at two geographic levels (community and district). It is found that the associations are subjected to park quality, transport modes, and geographic levels. In particular, we discover significant social inequalities in park accessibility under the mode of public transit, walking, and bicycle. Our study should provide some new insights into accessibility research and advance the understanding of unequal park provision in developing countries.

1. Introduction

1.1. Background

Efforts to advance ecologically and socially sustainable cities are frequently emphasizing the role of parks in promoting well-being and public health (Elmqvist et al., 2013; Haase et al., 2014). Parks within built environment, especially the non-private ones with free access, can offer a diversity of economic, social, ecological, physical, and psychological benefits to urban residents (Van Den Berg et al., 2010; You, 2016). For example, a wealth of literature has examined how the access to or usage of parks is associated with physical activity and health-related outcomes, including obesity (Alexander et al., 2013), mortality (Villeneuve et al., 2012), morbidity (Maas et al., 2009), chronic disease (Besenyi et al., 2014), mental health (Van Den Berg et al., 2010), and perceived health (Wolf and Wohlfart, 2014). Other studies have evidenced the positive effect of parks in provisioning ecosystem services, protecting biodiversity, and enhancing ecological functions and processes (Elmqvist et al., 2013; Haase et al., 2014; Nielsen et al., 2014). Additionally, public parks can act as unique third places for socialization, rejuvenation, recreation, and democracy, and therefore should contribute to social tolerance, economic vitality, and a sense of attachment (Wendel et al., 2012).

Urban dwellers can only enjoy the benefits from parks that are reasonably accessible (Tan and Samsudin, 2017). However, the dramatic urbanization has posed great threat to the connection between human and natural environment, especially in the developing countries (Maller et al., 2008; Maruani and Amit-Cohen, 2007). In particular,

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rapid urban growth has raised a wide range of land use conflicts and the capacity has been largely exceeded to provide enough green infrastructure such as parks for their citizens. As a consequence, public parks should not always be appropriately or equitably distributed over space. Many studies contend that the distribution of public parks within cities should be stratified for population segments with different age, gender, ethno-racial backgrounds, political rights, earning power, and other axes. Within this context, the uneven park accessibility has emerged as an essential social justice theme in geographical research.

Recent literature has saw growing efforts in identifying the geographically inequitable accessibility to parks for disadvantaged populations in many cities around the world, including Brisbane and Melbourne (Australia), Leicester (UK), Atlanta, Baltimore, Columbia, Missouri, North Carolina, and Phoenix (USA), Seoul (Korea), Cape Town (South Africa), and Singapore (Boone et al., 2009; Chang and Liao, 2011; Comber et al., 2008; Dai, 2011; Donaldson et al., 2016; Ibes, 2015; Koohsari, 2011; Lee and Hong, 2013; Oh and Jeong, 2007; Tan and Samsudin, 2017; Wang et al., 2015). Prior studies have demonstrated different indicators, approaches, and measures, and reported mixed and even contradictory findings (Paez et al., 2012; Rigolon, 2016). Actually, accessibility involves a variety of factors such as the physical road environment, transport modes, activity scope, and personal preferences (Lin et al., 2014; van Wee, 2016; Yang et al., 2015). Though former research has acknowledged the complexity nature of park accessibility, few studies have compared the park accessibility associated with different transport modes and examined how the difference varies along socioeconomic gradients. In addition, earlier studies were frequently conducted in the Western developed nations and little is known about the park accessibility in the non-Western counterparts (Wei, 2017; Xiao et al., 2017). Developing countries differ substantially with Western nations in social, economic, cultural, and political aspects. It thus should provide valuable insights for geographical theory by investigating the park accessibility under different transport modes as well as the associated social inequalities in urban settings of the non-Western countries.

1.2. Literature review

1.2.1. Measurement of accessibility

Accessibility is defined as the relative proximity or nearness from one place to another (Tsou et al., 2005). It fundamentally measures the ease to a specified destination from an origin (Widener and Shannon, 2014). Within the transport geographical research, park accessibility represents the accessed proximity between residents' address and parks (Rigolon, 2016). Earlier studies employed the 'container' approach that identified whether a good or service was distributed within certain administrative units. It incorporates two obvious shortcomings: (1) individual movements are restricted to certain geographic boundaries; and (2) large unit has a higher probability of containing more supply points. Following studies proposed the 'coverage' methods that calculated the population within the pre-defined distance from supply points. Typical 'coverage' methods include the buffer analysis, network analysis, kernel density estimation (Moore et al., 2008), Thiessen polygons (Boone et al., 2009; Sister et al., 2010), gravity-based service area (McCormack et al., 2010; McGrail and Humphreys, 2009), and floating catchment area (Zhang et al., 2011; Lee and Hong, 2013). The 'coverage' methods are sensitive to scale effects and somewhat arbitrary because: (1) it is difficult to determine an appropriate service scope; and (2) actual traffic conditions are usually ignored. In response, scholars started to consider the supply points (e.g., parks) outside the service scope (Kerr et al., 2011; Paez et al., 2012).

Following studies advocated the distance-decay function approach which uses the network distance instead of the Euclidean distance (Burgoine and Monsivais, 2013; Martínez and Viegas, 2013; Widener et al., 2015). Other researches argued that accessibility should be highly sensitive to transport modes (McKenzie, 2014). For example, Su et al. (2017) compared healthy food accessibility under four transport modes (e.g., public transit, private car, walking, and bicycle). Under the Western context, non-poor residents use private car for accessing goods and services (Jiao et al., 2012; Paez et al., 2009; Wang et al., 2014), while the deprived population typically relies on public transit to increase spatial accessibility (Bader et al., 2010; Widener et al., 2015). It is further pointed in some recent literature that the actual traffic conditions (e.g., traffic jam, speed limits, bus frequency, waiting length, restricted turn and one-way driving direction) associated with temporal component should be incorporated (Burgoine and Monsivais, 2013; Farber et al., 2014; Kwan, 2012; van Wee, 2016; Widener et al., 2015; Widener and Shannon, 2014). These studies have greatly advanced the accessibility measurement, however, the practice is still very lagged in park accessibility research.

1.2.2. Social inequalities of park accessibility

Social inequality recently emerges as a hot issue in the field of transport geography (Foth et al., 2013; Guzman et al., 2017; Hernandez and Rossel, 2015; Neutens, 2015; Power, 2012). A growing body of literature has associated park accessibility with varying degrees of racial-ethnic composition or socioeconomic status (Byrne and Wolch, 2009; Chang and Liao, 2011; Donaldson et al., 2016; Estabrooks et al., 2003; Harris et al., 2015; Hughey et al., 2016; Ibes, 2015; Landry and Chakraborty, 2009; Mcclintock et al., 2016; Schultz et al., 2017; Yasumoto et al., 2014). Scholars have reported mixed findings for the magnitude and direction of these associations. Some studies demonstrate that disadvantaged groups (e.g., low-income, less-education, minority, black population) have restricted park accessibility (Estabrooks et al., 2003; Harris et al., 2015; Gordon-Larsen et al., 2006; Taylor et al., 2007), while other cases discover that deprived populations enjoy higher access to more parks (Boone et al., 2009; Sister et al., 2010; Vaughan et al., 2013; Wolch et al., 2005). Additional publications also found no significant associations between park accessibility and socioeconomic characteristics (Gilliland et al., 2006; Hughey et al., 2016; Ibes, 2015; Nicholls, 2001). Several comprehensive reviews revealed consistent evidence of social inequalities in park accessibility (Macintyre, 2007; National Recreation and Park Association, 2011; Wolch et al., 2014).

Though previous studies have made substantial contributions to understanding the topic under investigation, some issues need to be further addressed. For one thing, the role of park quality (e.g., maintenance levels, service, amenities, canopy coverage, and facilities) is not frequently considered. Some personal surveys indicate that residents are prone to visit the parks with better quality although they are not the closest ones (Crawford et al., 2008; Goličnik and Thompson, 2010; Vaughan et al., 2013). For another, most investigations simply compare the accessibility across neighborhoods with gradients in sociodemographic characteristics. Some cases employed the ordinary least square linear (OLS) regression to generate empirical findings. Nevertheless, the efficiency and robustness of the OLS should be largely reduced given the spatial autocorrelated pattern of pubic green spaces (Wan and Su, 2017; You, 2016). Moreover, sociodemographic characteristics are hierarchically nested at different levels (Su et al., 2017). The OLS ignores the hierarchical organization and may produce biased estimations (Su et al., 2017). In this regard, we should utilize more sophisticated analysis tools to capture the social equalities of park accessibility by incorporating the park quality, transport modes, spatial autocorrelation, and multilevel socioeconomic characteristics.

1.3. The present study

Our study aims to fill in the literature gap by characterizing the social inequalities of park accessibility in China. The Chinese government has placed high priorities on urban park provision for building a well-off society. However, little evidence has been released regarding whether or not urban residents have equitably access to parks.