



Characterizing the inequalities in urban public green space provision in Shenzhen, China



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ABSTRACT

Public green spaces (PGSs) play a critical role in enhancing human well-being and urban quality of life. Characterizing the inequalities in PGSs provision can provide essential references for urban planning. This paper employs spatial regression to examine the PGSs provision in association with district socio-demographics in Shenzhen, China. In particular, district sociodemographics are described by ten variables from five aspects: income, occupation, education, demographic structure and housing arrangements. The PGSs provision is measured by six indicators from three aspects: quantity, accessibility, and quality. Results show that PGSs quantity declines with district disadvantage degree of income, occupation and housing. PGSs present lower quality in the wealthier neighborhoods but better quality in districts with housing disadvantage. The socioeconomically disadvantaged districts have more restricted access to PGSs. These findings demonstrate the inequalities in UPGSs provision in Shenzhen. This study informs urban planners of the ‘oasis and desert’ of PGSs provision across space.

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1. Introduction

Green spaces play an essential role in enhancing human well-being and urban quality of life (Kabisch & Haase, 2014). They not only provide the urban residents with ideal arena where they can leisure, communicate and socially interact, but also offer a diversity of health benefits through pollution control and noise reduction (Gupta, Kumar, Pathan, & Sharma, 2012; Krellenberg, Welz, & Reyes-Päcke, 2014). Green spaces can be categorized into two types (private and public) according to their ownership. The private green spaces refer to the outdoor amenities within private urban residence whose accessibility is restricted unless permitted by the household owners. Conversely, the public green spaces (PGSs) represent those that can be accessed freely and treated as public goods (de la Barrera, Reyes-Päcke, & Banzhaf, 2015). The PGSs in

urban cities include the natural places dominated by green vegetation (e.g., forests, woods, gardens, and parks) and the artificial green spaces (e.g., roadside greenbelts, riverside greenbelts, green spaces around residence, green spaces around institution, squares and plazas) (Chen, Liu, & Liu, 2016; Shan, 2014; de la Barrera et al., 2015). In most cases, the PGSs are not evenly distributed in space within the urban cities (Barbosa et al., 2007; Ernstson, 2013; McConnachie & Shackleton, 2010). The scientific community raises the concern about the social inequalities in PGSs provision, since the urban residents and communities do not enjoy equal opportunity in PGSs accessibility and usage (Broussard, Washington-Ottombre, & Miller, 2008; Davis et al., 2012; Kabisch & Haase, 2014; Wright Wendel, Zarger, & Mihelcic, 2012).

Scholars have shown increasing interest in characterizing the social equalities in PGSs provision. Yao, Liu, Wang, Yin, and Han (2014) and Kabisch and Haase (2014) used the Gini index to measure the unequal distribution of PGSs among the urban residents. Some studies compared the PGSs amount among different demographic communities and reported that immigrant communities are characterized by lower PGSs accessibility (Barbosa et al., 2007; Martin, Warren, & Kinzig, 2004; Pham, Apparicio, Séguin, Landry, & Gagnon, 2012). Others focused on the disadvantaged groups and found that Leicester's Hindu groups (Comber, Brunsdon, & Green, 2008) and Atlanta's Africans (Dai, 2011) were less accessible to PGSs. McConnachie and Shackleton (2010) investigated 9

Abbreviations: PPC, PGSs per capita; PP, PGSs percentage; PUL, PGSs per urban land; CPGSs, Total communities within PGSs service scope; PPGSs, Total population within PGSs service scope; PLH, Percentage of low-income household; PBW, Percentage of blue-collar workers; PPLU, Percentage of people in long-term unemployment; IR, Illiteracy rate; PPD, Percentage of people with degree below middle school; PHKT, Percentage of households without kitchens or toilets; PHFH, Percentage of households without fixed housing; POP, Percentage of old people above 60; PCT, Percentage of children and teenagers below 18; PFP, Percentage of float population.

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small towns in South Africa and discovered that the suburban areas dominated by black South Africans are poorly endowed with PGSS. Majority of previous studies focused on the quantity aspects and recent publications advocated to measure the social inequalities in PGSS provision using an integrated manner. For example, Schipperijn, Stigsdotter, Randrup, and Troelsen (2010), Gupta et al. (2012), Yao et al. (2014), Krellenberg et al. (2014) and de la Barrera et al. (2015) described the PGSS provision from three aspects, including quantity, quality, and accessibility. Shanahan, Lin, Gaston, Bushd, and Fuller (2014) measured the inequalities associated in PGSSs provision by considering the neighborhood wealth, ethnicity, education, and housing arrangements. In order to deepen the understanding of social equalities in PGSSs provision, consequently, it requires to comprehensively analyze the PGSSs quantity, accessibility, and quality in associations with a diversity of neighborhood sociodemographic variables. Such analysis can effectively inform the urban planners of the most vulnerable communities (Haaland & van den Bosch, 2015). However, very few efforts have been spared on this specific issue, especially in developing countries.

Adopting a systematic form of urban planning, the Chinese government has adopted a number of regulations and policies to increase the PGSSs in urban cities in the last two decades (Chen & Hu, 2015; Zhao et al., 2013). Different from the developed nations, the urban green spaces in China are generally public and provisioned by the government. Despite China has made great achievements in increasing PGSSs provision, the knowledge of the social equalities in PGSSs provision is still limited. Zhao et al. (2013) reported the variations in PGSSs provision among the eastern coastal region, the western region, and the central region in China. Chen and Hu (2015) obtained a negative relationship between land finance and PGSSs provision with increasing urbanization and concerned on the social inequity in PGSSs accessibility. However, due to the lack of fine scale observation data, the intra-urban social inequities in PGSSs have been rarely reported. Shenzhen, China's first Special Economic Zone, is reputed as the pioneering city in economic reform (Weng, Pi, Tan, & Su, 2016). It bothers with Hong Kong and locates within the Guangdong Province in southern China

(Fig. 1). Covering about 1990 km² and inhabiting 18 million population, Shenzhen is faced with great challenge of land shortage, resulting in obstacles to green spaces provision. For example, the high density of built-up land makes it difficult to introduce green elements (Chen et al., 2016). Shenzhen is exemplary of China's urban issues and should be a critical case to characterize the social inequalities in PGSSs provision.

Using the case of Shenzhen, this paper aims to characterize the social inequalities in PGSSs provision by analyzing its association with district sociodemographics. The specific objectives are to: (1) describe the PGSSs provision by measuring its quantity, accessibility and quality; (2) examine the relationships between PGSSs provision indicators and diverse district sociodemographic variables; and (3) discuss the social inequalities in PGSSs provision and inform the urban planning.

2. Materials and method

2.1. Mapping public green spaces

I employ visual interpretation to extract Shenzhen's PGSSs information from the 0.5 m resolution color-infrared aerial photos in 2008. In particular, I imported these photos into ArcGIS 10.2 and georeferenced them to the WGS 84 coordinates. Experienced surveying and mapping workers performed the interpretation at 1:10000 scale. They delineated the boundary of PGSSs and saved the polygons with attributes of PGSSs. The PGSSs in Shenzhen include the parks, small gardens, urban forests, plazas and squares, roadside and riverside greenbelts, and institutional and residential green spaces. The final interpreted PGSSs information is shown in Fig. 1.

2.2. Description of PGSSs provision

Following the prior literature (de la Barrera et al., 2015; Gupta et al., 2012; Krellenberg et al., 2014; Schipperijn et al., 2010; Yao et al., 2014), this paper describes the PGSSs provision from three aspects: quantity, accessibility, and quality. The quantity aspect denotes the relative amount of PGSSs compared to the population

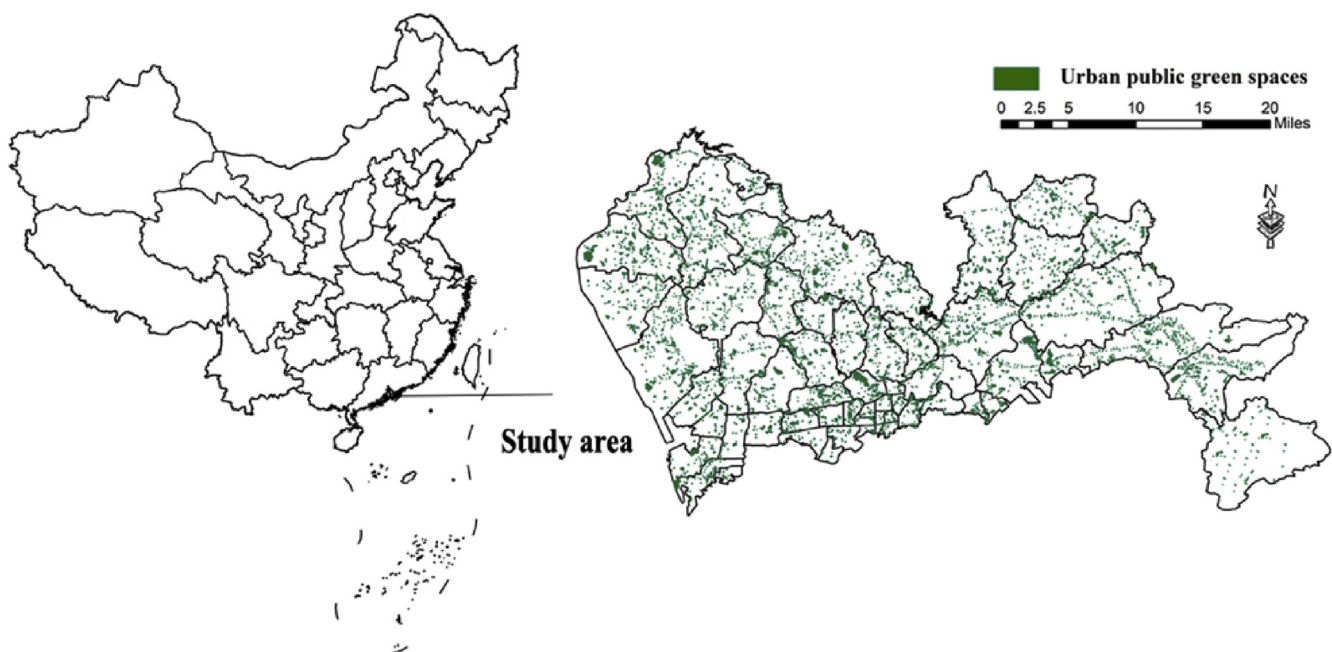


Fig. 1. Location and district divisions of Shenzhen (China) as well as the public green spaces within it.

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