An assessment of urban park access in Shanghai - Implications for the social equity in urban China

Abstract:

The question whether urban green resources are equitably distributed across different social groups is a major concern of social equity and environmental justice for both governments and scholars. This topic is particularly relevant for rapidly developing countries such as China where inequality is growing. This paper examines whether and to what extent the distribution of urban park services is equitable for marginalised population in China. We choose Shanghai as the case study and took into account three dimensions of group delineation, namely demographic characteristics, social economic status and social spatial structure. We employ the spatial clustering method to assess the similarities and differences of the association between the spatial patterns of accessibility to urban parks among different social groups. Interestingly, we found that vulnerable groups are favoured over more affluent citizens. Local municipal endeavours have ensured that the access to Shanghai's parks remains socially equitable. Additionally, we attributed it to the path dependence of China's socialism legacy before the market-oriented reforms.

Keyword: Social equity, Environmental justice, Marginalised groups, Park access, Shanghai

1.0 Introduction

Green space, as a key ecological factor of the built environment, has many acknowledged economic and ecological benefits including improved air quality, mitigating the urban heat island effect, increased provisions of recreational opportunities, enhanced aesthetic value, promoting physical and mental health and encouraging people's sense of spiritual well-being (Wolch et al., 2014, Byrne and Wolch, 2009, Byrne et al., 2009, Hughey et al., 2016, Xiao et al., 2016, Nowak et al., 1996, Floyd and Johnson, 2002). Most studies contend that within cities, green space is not always equitably distributed, and people's access is often highly stratified based on income, ethno-racial characteristics, age, gender, (dis)ability, paucity of political power and other axes of difference (Lineberry, 1977, Byrne et al., 2009, McConnachie and Shackleton, 2010). In this vein, the uneven accessibility of urban green space has become recognized as an environmental justice issue to both scholars and governments. There is a growing literature on the social equity of green space, which examines the distribution of green space resources in neighbourhoods with varying degrees of socio-economic status (SES) or racial/ethnic composition (Byrne et al., 2015, Ibes, 2015, Hughey et al., 2016, McClintock et al., 2016, Yasumoto et al., 2014, Landry and Chakraborty, 2009, Jacobsonô et al., 2005, Talen, 1997, Chang and Liao, 2011).

Despite the relevance of environmental justice to the sustainable development of Chinese cities, so far there exist little empirical evidence in urban China (Wolch et al 2014). Existing research on inequality in urban China have mostly studied the equity between different social groups in terms of employment opportunities and living conditions (Wu et al., 2010, Wu, 2002, Wu, 2004, Fan, 2002, Logan et al., 2009). Furthermore, although urban parks are regarded as an urban planning priority, it is largely unknown whether this resource is equitable distributed in China. The little evidence available so far infers that access to urban green spaces in China's megacities is worsening (Chen and Hu, 2015). The social inequality literatures show that the transition of China's economy has transformed a society once characterised by egalitarianism into one that is experiencing an increasing income gap between the rich and the poor (Wu, 2004, Sicular et al., 2007, Logan et al., 1999). Increasing social inequality is also reflected in the residential distribution of residents as studies reveal that the residential segregation in Chinese cities is mainly based on tenure and socio-economic factors (Li and Wu, 2008). So far evidences indicate that high-income households tend to rely less on public services as they live in privately serviced neighbourhoods (Li et al., 2012, Shen and Wu, 2013). Disadvantaged groups such as rural migrants and low-income households congregate in the rented sector largely consisting of older settlements and dilapidated inner-city neighbourhoods (Li and Wu, 2008, Liao and Wong, 2015, Wang et al., 2015b, 2016). The increasing spatial segregation between the affluent and the poor therefore intuitively raises the concern whether the provision of public resources such as access to basic infrastructure is equitable. The findings would also have important implications for municipal decision-making in service allocations and resource distribution in against the context of developing countries such as China.

Consequently, the aim of this study is to assess whether and to what extent the distribution of urban park services is equitable for the marginalised population in urban China. We chose Shanghai as our case study, since it is the largest and most prosperous Chinese city, which is also experiencing serious residential segregation problems (Wu and Li, 2005, Li and Wu, 2008). Compared with most extant urban China studies, which largely rely on national census data at the sub-district level, our study makes use of fine resolution population data at the *juweihui*, (residential committee) level from the 6th census of 2010. This would allow us to take into account the variations of spatial characteristics at the local level. A further strength of this study is that we adopt the accessibility measurement approach from Talen (1997, 1998) and Talen and Anselin (1998), since the traditional 'container' approach divides a particular urban area into smaller zones, such as neighborhoods or census tracts, which fails to consider people's self-movement and spatial externalities of facilities (Talen and Anselin, 1998, Nicholls, 2001). Moreover, we use the local indicators of spatial association (LISA) method (Anselin, 1995) to examine the association between the distribution of public parks and the spatial congregation of different social groups. The advantage of the LISA method is that it can identify the local association between an observation and its neighbours, and visualize their interaction patterns over space, in the forms small clusters or insignificant outliers (Anselin, 1995).

The paper is structured as follows: part two reviews the existing discussion regarding the social equity and environmental justice of access green space. Furthermore, we examine the existing research on social inequality in urban China, in order to develop our theoretical framework. Part three explains the methodology adopted in this study and our data sources. Analysis and results are presented in part five and the final section provides a summary of key findings and important policy implications.

2.0 Social equity and access to urban green space

The issue of equal access to public services has become important for governments due to growing concerns in practical policy making (Hastings, 2007, Tsou et al., 2005, Brambilla et al., 2013). There is a long tradition of studying the distribution of urban service delivery in the context of social equity and environmental justice, including playgrounds (Witten et al., 2003), parks (Chang and Liao, 2011, Crompton and Lue, 1992), street trees (Landry and Chakraborty, 2009), amenities (Lowe, 1977, Tsou et al., 2005) and public transit connectivity (Welch and Mishra, 2013, Jacobsonô et al., 2005). Parks and open green space, as a fundamental element of the built environment and as a basic public service provided by the government, is therefore a key target for research (Besenyi et al., 2014, Boone et al., 2009, Floyd and Johnson, 2002, Xiao et al., 2016). The core concern from a environmental justice perspective, is the spatial distribution of public goods and services, and most importantly, whether this distribution is in accordance with the varying needs of different social group's socio-economic status, ethno-racial characteristics, age, gender, (dis)ability, paucity of political power and other axes of difference (Lineberry, 1977, Byrne, Wolch, & Zhang, 2009; McConnachie and Shackleton, 2010, Harvey, 1973, Jacobsonô et al., 2005). The notion of *geographies of need* by Harvey (1973) suggests that localities with a larger presence of disadvantaged residents are in need for better access to public services and goods**.**

Existing findings have been largely mixed in terms of the direction and magnitude of the association between green space distribution and marginalised social groups (Hughey et al 2016, Wolch et al 2014). Earlier research indicates that areas with a higher share of marginalised residents, are not disadvantaged with respect to the spatial allocation of public facilities such as urban parks. For example, Lineberry (1977) asserted that poorer neighbourhoods are in fact favoured in terms of park distribution. Mladenka and Hill (1977) found no particular discrimination against low-income neighbourhoods. Moreover, in Chicago Mladenka (1989) found that race was not a determining factor of park facility distribution, though social class could possibly be a determinant. Instead, it is argued that the determinants of social equity specifically regarding public facilities are more exposed to bureaucratic and professional decision-making processes (Koehler and Wrightson, 1987).

Recent studies disagree with the ‘unpatterned’ occurrence of inequality. Instead, several researchers found that the patterns of race and area poverty have become significant determinants with regard to access to park facilities, with evidence existing for several countries. For example, Talen’s (1997) study on park accessibility and race in the cities of Pueblo, Colorado and Macon, Georgia found that ethnic minorities were more likely to be living in areas with lower levels of park access. With regards to area poverty, Erkip (1997) revealed that access to parks and recreational facilities in the city of Ankara is mainly dependent on individual’s level of income. Jones et al (2009) examined the distribution of access to parks among the residents of Birmingham, England and found evidences of disparities in provision related to socioeconomic deprivation. Wolch et al. (2005) and Sister et al. (2007) found that communities with Latinos, non-white or low-income groups have worse access to parks in the American context. Landry and Chakraborty (2009) investigated the environmental equity of ‘green resource-street trees’ in Tampa, Florida and identified that their spatial distribution is inequitable with respect to race and ethnicity, income, and housing tenure. In the city of Yokohama, Japan, Yasumoto et al (2014) adopted a longitudinal approach to investigate the association between socio-demographic indicators and public park provision over an eighteen-year period, and found that new parks are located in more affluent communities. Moreover, recent studies drawing upon the concept of environmental justice contend that more focus need to be placed on how and why people use urban parks (Byrne and Wolch 2009). In this regard, Hughey et al. (2016) examined the quality of parks in south-eastern US and found that disadvantaged neighborhoods tend to have parks with poorer quality whilst Ibes

(2015) provided a novel approach to classifying the urban parks according to their physical, land cover and built features.

2.1 Social inequality in China

The concept of social equity and access to public facilities is still relatively new in the Chinese context, and research conducted at the neighbourhood level is particularly scarce. However, this does not mean that social inequality does not exist in China. In fact, social inequality has become one of the most scrutinized areas for scholars of urban China especially since the transition to a market based economy (Logan et al., 2009, Sicular et al., 2007). The evidence to date suggests that China's transition to a market economy has transformed a society once characterised by egalitarianism into one that is experiencing an increasing income gap between the rich and the poor (Sicular et al., 2007). So far studies on inequality in China have focused on the unequal level of individual socioeconomic achievements, the provision of amenities primarily between different regions (Zhang and Kanbur, 2005), and the income disparities among different social groups (Fan, 2002).

With respect to who is disadvantaged in Chinese cities, studies have identified two vulnerable groups who are considered to be the new urban poor. The first group consists of laid-off workers lacking skills and education, which prevents them from finding new employment or moving out of their deprived neighbourhoods (Wu et al., 2010). The second group consists of rural migrants who are much more likely to be working in poorly paid and dangerous jobs compared to native residents (Solinger, 2006). The key obstacle for rural migrants to improve their life in the host society is the so-called hukou system, which prevents rural hukou holders from accessing the urban welfare system (Chan, 2009) as well as public housing facilities (Logan et al. 2009). The reigning socio-economic inequality has also led to residential segregation, which is largely centred on tenure and affordability (Li and Wu, 2008). Therefore, especially those who are excluded from affordable housing such as rural migrants are much more likely to be renting from the private sector, which is mostly located in low-income areas (Li and Wu 2008). Segregation also means that the urban poor and rural migrants are disproportionately more likely to be living in deprived neighbourhoods, which in turn further increase the likelihood of poverty (Wu et al., 2010). In contrast, middle class residents tend to be living in newly developed commodity housing estates, which are usually equipped with better public amenities compared to low-income areas (Li et al. 2012). In addition, residents in commodity estates tend to have less demand for public resources since green space and communal facilities are usually provided within the estate (Xiao et al. 2016; Shen and Wu 2013). Overall in urban China, marginalised social groups experience unequal access to various resources such as the job market or the housing market.

To our knowledge, in relation to green space in China, there are some initial findings although their main focus is on green space activities rather than access to parks per se. For instance, Byrne et al. (2015) conducted a survey for Hangzhou to explore how people's responses to climate change may be related to their local green infrastructure. Wang et al. (2015a) adopted a comparative framework, revisiting the exogenous factors for people's self-reported park usage over China and Australia and Zhang et al. (2015) examined the determinants of young residents' satisfaction levels when participating in physical activities in urban green spaces.

The existing social inequality literature signals that marginalised groups including laid-off state workers and rural migrants, may suffer from inequality such as lack of public resources and residential segregation (Li and Wu 2008). At the national level Chen and Hu (2015) found a negative relationship between economic development and urban public green space, signaling that access to urban green spaces in China's megacities is worsening**.** At the Jiedao level (similar to UK ward level) Yin and Xu (2009) examined the spatial distribution of urban parks based on the 5th national census and found that urban parks are spatially matched with Shanghai's population density. However, the question whether there is equitable access to urban parks for different social groups remains unanswered. Little is known whether marginalised groups also have poorer access to services in a denser populated context such as China, where the provision of green space has always been scarce and the quality of service provision for the entire population is considerably lower. In this vein, this study approaches a environmental justice framework (Wolch et al 2014, Hughey et al 2016, McClintock et al 2016, Talen, 1997), exploring whether the present urban park distribution has a particular discrimination for marginalised population during rapid urban growth, as the shortage of these facilities may lower the life chances of its residents as well as their mental and physical health.

3.0 Methodology

3.1 Study area and data source

This paper uses Shanghai as the case study since it is one of the fastest developing cities in China where the rise of social inequality has been especially dramatic (Li and Wu 2008). Being the key financial centre of China, Shanghai is also known as the most populous 'city proper' in the world with growth rate of 37.53 per cent from

16,737,734 in 2000, meaning that there are 6.6 million people moving there annually. The proportion of migration increased from 18.6 per cent in 2000 to 39 per cent in 2010 (NBS 2010). With 6000 people per square kilometre in 2012 Shanghai's population density is also considerably higher compared to other world cities such as Tokyo (4300/km^2), New York (1800/km^2) and Paris (3800/km^2) (Demographia World Urban Area, 2014). The Shanghai municipal government is placing great emphasis on the provision of green recreational amenities in order to improve the local ecology system, as well as adding significant public benefits including aesthetic enjoyment, increased recreation, and access to clean air. According to the Shanghai statistical yearbooks (2000-2011), the green space of metropolitan area had reached 37.1 km^2 in 2011, which is double that of 1997. Moreover, the green cover ratio increased from 22.2 per cent to 38.2 per cent in the period from 2000 to 2011 while the green space per capita increased to 13.1 m^2 compared with 4.6 m^2 in 2000.

Our study area focuses on the metropolitan area of Shanghai, which is mainly within the external ring road comprising of nine administrative districts: Huangpu, Luwan, Xuhui, Changning, Jing'an, Putuo, Zhabei, Hongkou,Yangpu and Pudong, where the population density is 16,828 per km^2 at the area of 660 km^2.

[FIGURE 1 HERE]

[FIGURE 2 HERE]

The data for this study is drawn from several primary sources. Firstly, local socioeconomic information at the "juweihui" level (similar to the US census tracts level) is taken from the Sixth National Population Census of the People's Republic of

China 2010 and any blocks located outside of the metropolitan area were excluded from the analysis. Secondly, details on urbans park locations were derived from the Shanghai Environmental Protection Bureau. In total, there are 366 public parks in Shanghai and 216 parks are within the 15.7 km^2 boundary of our study area. Thirdly, the street network information is taken from the Shanghai Municipal Bureau of Planning. Before the estimation, we digitized all the information in the geographic information system. Table (1) summarizes all the variables employed in this study as well as the general descriptive statistics. There are 2730 samples in total, and it is seen that the variables selected, namely that of social class characteristics are categorized into three dimensions, including the general demographic characteristics, urban spatial structure and social-economic status. The first dimension calculates the portion of people in census block under the age of 20, above the age of 60, with their local city being Hukou, their unemployment rate and marriage rate. The second dimension is mainly concerned with local residents and migration population density. Since income level is not available, we therefore rely on housing type as an indicator of one's social-economic status. As a rule of thumb it is assumed that individuals with high incomes would purchase commodity housing for a higher quality of life, and those with low incomes would choose affordable housing units. Finally, the access level shows the results of the amount of park acreage located within 1.5 km and 3.2 kmof each census block via the existing street network.

[TABLE 1 HERE]

3.2 Urban park access as an aspect of social equity

We chose urban parks as our measure of social equity as green parks offer a variety of health and economic benefits (Besenyi et al., 2014, Xiao et al 2016, Wolch et al 2014) and a space for social interaction and creating a sense of belonging for marginalised groups (Byrne and Wolch, 2009, Hughey 2016). Recall that, this study attempts to understand the spatial association pattern of park access with different social groups and examine whether urban resources are distributed equitably for the socio-economic characteristics of residents in urban China. Since, Wolch, Byrne and Newell (2014) stated that despite a growing literature, there is no consensus among scholars about how to measure green space access. The common approach is to employ GIS, measuring accessibility (Oh and Jeong, 2007), therefore, this study follows Talen (1997, 1998) and Talen and Anselin (1998)'s framework to investigate the relationships between equity of public parks and the socio-economic characteristics of the populations in a given area. Generally, their procedure involves three stages: the first step is to measure accessibility to facilities (parks in this case), then to map and spatially cluster accessibility value of each census unit using the technique of Local Moran LISA statistic. Finally, a standard two-sample test (Mann–Whitney U test) is employed in order to investigate whether the socio-economic characteristics of blocks with high and low access to public facilities is statistically equal.

3.3 Measuring accessibility to parks

The notion of "accessibility" has become a central concept in physical planning and is widely considered a useful tool for policy assessment (see Neutens et al. 2010 for a summary of the existing measurement of accessibility for urban service). The present methods for measuring spatial accessibility of neighbourhood parks in the literature can be categorized into three general approaches (Zhang et al., 2011), including the travel cost approach, the container approach and gravity model-based approach. However, recent studies reveal that these geographical approaches cannot fully capture the actual park users' activities since they do not consider the mental barriers to park usage (Byrne and Wolch, 2009).

Nevertheless, this study adopts the accessibility measurement from Talen's (1997), which belongs to the gravity model-based category. It has two theoretical advantages. Firstly, the direct (Euclidean) distance measures of park accessibility are intuitive but not realistic. Nicholls (2001) states that the estimation would be inaccurate if the straight distance method is utilized to identify the radii of the targeted area. Therefore, the travel distance computed by the shortest route algorithm via a street network analysis appears more suitable, as it captures the actual routes that all groups of people are likely to use to reach the public facilities (Talen, 1997). Secondly, the container approach seems problematic due to the issue of Modifiable Areal Unit Problem (MAUP), which ignores the spatial size of geographic containers. The traditional 'container' approach divides an urban area into smaller zones and calculates the amount of parkland available to residents within each of these units (Talen and Anselin 1998). However, Talen and Anselin (1998) argue that such estimations are inappropriate, as they assume the benefits of services provided are allocated only to residents within the predefined zone. In fact for true public goods, service provision is not limited to specific geographic boundaries, therefore such an assumption ignores people's self-movement and the spatial externalities of facilities (Nicholls, 2001). Consequently, this study adopted the gravity model-based approach, measuring the access level referred to in the covering model (Hodgart, 1978) to characterize and compare the accessibility of parks, taking into account both the park size and distance to parks within certain distances for each given census block (Talen and Anselin, 1998). By using an existing administrative spatial unit (juweihui in our case), which is then comparable to other existing studies, we can therefore avoid any arbitrary spatial unit definitions. The formula for this measurement is as follows:

Z□□=□□□□□□□ （Equation 1）

Where, S_j is the number of facilities or their size (we use size for this study), d_{ij} is the network distance between tract i and facility j, and α is the search of distance (radii). It is noted that two critical distances radii (α) are used: 1.6 km (15 minutes walking distances) and 3.2 km (15 minutes cycling distance). Since, a distance of 1.5 km is the criteria for park access given in De Chiara and Koppelman (1975); the 3.2 km distance is the criteria used to test the sensitivity of park access in Macon and Georgia (Talen 1997). It is known that Shanghai like most mega cities in developing countries is highly populated, and green public resources per capita is thus very scarce; it is assumed that people would be more inclined to pay higher travel cost (time and distance) to access the green spaces. Therefore, we also included two radii area to represent different access behaviours, such as walking and cycling.

3.4 Analysis methods

The analysis method of this study is divided into two steps. Firstly, we follow Talen's (1997) and Li et al. (2015) approach, using local indicators of spatial association (LISA) (Anselin, 1995) to determine the existence of statistically significant spatial clusters of single or bivariate variables. Furthermore, it also gives us an indication of the spatial non-stationarity, outliers or spatial regimes, similar to the use of the Moran scatterplot in Anselin (1996). Its formula is defined as:

I□=(□□□□□2)□□□□□□ (Equation 2)

Where, zi and zj are expressed in deviations from the mean, and w_{ij} is the spatial weight. The summation over j is across each row *i* of the spatial weights matrix.

Indeed, the key strength of LISA indicator is to allow for the detection of significant patterns of association around an individual location, including hot spots and spatial outliers (Anselin, 1995).

According to Talen and Anselin (1998) there are very few instances in the existing literature that outline the spatial association pattern of accessibility with socioeconomic characteristics. In this respect, they suggested that the bivariate treatment of local indicators of spatial association (LISA) (Anselin, 1995) is the most suitable approach for this research objective. Nevertheless, the second task of this research, which is to assess whether nor not the distribution of urban park services is equitable for marginalised population sub-groups, is reliant on the univariate treatment in LISA technique, which only considers the accessibility level of each census area.

Secondly we apply the Mann-Whitney U test in order to discern the spatial distributional relationship between population characteristics and access to parks. For instance, the test can explore whether census areas with a large share of low-income or aging population have better access to parks than the wealthier and younger neighbourhoods. The Mann–Whitney U test compares measures of location for two groups, blocks with high access vs. blocks with low access based on the clustering result above, examining whether accessibility favors one particular socioeconomic group over another or equal. The formula of Mann Whitney U statistic is defined as:

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - \sum_{i=n_1+1}^{n2} R_i \qquad \text{(Equation 3)}$$

$$z = \frac{U - m_U}{\sigma_U}, \quad \text{(Equation 4)}$$

Where, n_1 and n_2 are the sample size of each group, and R_i is the rank. mU and σU are the mean and standard deviation of U. In most circumstances, a two-sided test is required for Z score, which means the sign of estimation results has different meanings. For example, the lower side test (negative sign) presents that Group 1's values tend to be smaller than Group 2's values, while the upper side test (positive sign) shows Group 1's values tend to be larger than Group 2's values.

4.0 Analysis results

4.1 Spatial clustering of social groups and park access distribution

In order to evaluate the spatial pattern between park access and socio-economic characteristics we firstly analysed the mapped spatial distribution of three variables, namely welfare housing (as an indicator for low-income households), commodity housing (as a proxy for high income) and the presence of migrant residents. Figures 2, 3 and 4 display the spatial clustering of socio-economic indicators and the distribution of parks, which is calculated with the LISA bivariate measurement. Areas shown in red are neighbourhoods that have a high presence of the social group defined by the three indicators above as well as high access to park facilities. Blocks coloured in light blue are areas that have a low percentage of the social group but a high level of park access. Only the blocks that are statistically significantly are shaded.

[FIGURE 3 HERE]

[FIGURE 4 HERE]

[FIGURE 5 HERE]

Figure 2 shows the distribution of migrant residents and park access and reveals that most of the areas with high percentages of migrants and high rates of park access are located within the inner ring of the city, with old districts such as Huangpu and Xuhui displaying the highest accessibility for migrant residents. One possible explanation for this outcome could be because rural migrants living in inner city Shanghai tend to be residents of physically dilapidated low-income neighbourhoods that are awaiting regeneration. Surrounding neighbourhoods that have already undergone redevelopment, have gained more green space, as part of Shanghai's public green space plan (Shanghai Municipality 2001). In comparison, blocks with low access to parks but have a high presence of migrant residents are mostly located in the peri-urban areas, which are still dominated by light industrial uses. With regards to welfare housing, most high-high neighbourhoods are situated outside of the outer ring road of Shanghai and are relatively concentrated. There are considerably fewer blocks with low park access and high welfare housing percentage, suggesting that the Shanghai government's planning considers proximity to urban parks as a requirement for welfare housing developments. In contrast, commodity-housing neighbourhoods are more likely to be located in areas with low park access, as figure 4 reveals that the light blue shaded blocks are much more prevalent than high-high blocks. The fact that most commodity housing blocks are located in the outer areas of Shanghai suggests that the provision of park access has not kept up with the private housing development rate. Information on the date and number of parks built so far in Shanghai confirms this explanation (SADACA 2014). Whilst the majority of existing parks were built in the 60s and 80s, only a small number of parks have been built since the millennium. However, the greatest surge of private housing developments have taken place after the millennium thereby affirming that provisions of park spaces has not been a top agenda for private developers as well as the government.

4.2 Socioeconomic characteristics of high-access neighbourhoods and low-access areas

Table (2) shows the median scores of the socioeconomic indicators of two types of areas, namely areas with high access to urban parks and areas with a low access to parks. In order to test whether there is a significant difference in the distribution of certain social groups in relation to access to urban parks, we employ the Mann-Whitney U-test to test each set of socio-economic characteristics. The U-test is non parametric and the null hypothesis is that there exist no significant difference between the two sets of data with regards to park access and that the data sets could have been sourced from a common population (Talen 1997).

[TABLE 2 HERE]

Both the model results of the one-mile (1.6km) and two-mile (3.2km) range yielded very similar results except for unemployment rate and shows that there is a very stark difference between social groups in terms of park access. Firstly with regards to demographic characteristics the U-test reveals that areas with high access to parks measured both at the 1.6km and 3.2km range tend to have a larger percentage of people above the age of 60. In comparison areas with low access to parks tend to have a significantly higher share of residents below the age of 20. Moreover, the percentage of married households is also considerably higher in neighbourhoods with a lack of public parks. Housing choices and demand for different amenities could be a reason for this outcome as married families with children prefer areas with better access to schools and shopping facilities whilst elderly people may choose parks for recreational purposes. In addition, areas with higher population densities are associated with better park access, which suggests that the distribution of parks is relatively equal amongst the population. In terms of the longstanding argument that the migrant population is highly disadvantaged compared to the urban population (Fan 2002; Li and Wu 2008; Wu et al. 2010) the U-test results shows that the distribution of park facilities appears to be in favour of marginalised groups. The share of migrant residents is significantly higher in high park access areas whereas the percentage of native Shanghai residents is significantly larger in neighbourhoods where urban parks are not in close vicinity. However, it is important to note most areas with high park access and high migrant population percentage is located in the inner city of Shanghai where many housing blocks are of a poor physical quality and have a high share of low-income residents (figure 2). In comparison, areas where there is good access to urban parks but has a low share of migrant residents tend to be newly developed commodity neighbourhoods such as the Lianyang area in Pudong New District where the estate itself already provides an abundant level of private green space.

With regards to the effects of financial wealth and access to parks, the U-tests yielded some very surprising results. Firstly, compared to low park access areas, high park access neighbourhoods have a higher share of welfare housing. In other words, areas with a poor access to public parks have significantly lower percentage of welfare housing. Secondly there appeared to be no discrimination in terms of public park access for residents in affordable homes as there is no significant difference in the distribution of this type housing between the high and low access neighbourhoods. Moreover, the percentage of unemployed residents also does not significantly differ between areas with good access to parks and neighbourhoods with poor park access measured at the 1.6km distance range. In fact, measured at the 3.2km range the percentage of unemployed residents is significantly higher in high access neighbourhoods as compared to low access areas. There are several possible explanations for these outcomes. Firstly, we speculate that the Shanghai government has been considerate of the need for recreational facilities of working class residents and low-income families and devised land use policies according to their needs. A further reason could be that most marginalised groups tend to congregate in the inner city and within the outer ring area, parts of the city that are more likely to have parks (SADACA 2014).

In contrast to the positive effects of economic disadvantage, the percentage of residents living in commodity housing neighbourhoods is significantly higher in areas where there is poor access to park facilities. This is surprising as residents in commodity housing are usually more likely to be home-owners as well as more affluent and thus in a better position to exercise greater degrees of choice regarding the location and access facilities for their accommodation. We speculate that the reason for this outcome could be related to the provision of private recreational facilities in gated communities. This would also explain why local natives are also living in low park access blocks since according to the findings of Li and Wu (2008) native Shanghai citizens are more likely to be homeowners.

5.0 Conclusion

Many studies have noted that inequality is worsening in urban China and is also reflected in the residential location and tenure of social groups (Li and Wu 2008; Logan et al. 2009). Whilst affluent households mostly live in commodity estates developed through the private market, disadvantaged groups such as rural migrants are more likely to live in rented properties (Li and Wu 2008; Wu 2004; Liao and Wong 2015; Wu et al. 2010). Consequently, there are growing concerns that the unequal residential distribution of social groups may affect their access to public facilities. Despite the importance of this issue, little is known whether public resources are distributed equally amongst all the residents in urban China during this especial era. In order to address this question, our study explored whether the provision of public parks is equal amongst all social groups using the case of Shanghai. Our findings show that in Shanghai low-income social groups are not disadvantaged in terms of access to urban parks. The U-test results provide a highly positive outcome in terms of social equity and access to parks as marginalised groups such as migrants, unemployed individuals and residents of welfare housing are more likely to live in areas with better park access when compared to the general population.

We speculate that there are two possible explanations for this outcome. Firstly, the outcome may be related to Shanghai municipality's urban green space planning strategy, which emphasises on an even spatial distribution of public green space (Shanghai Municipality 2001) and the planning legacy of China's socialist era. The Chinese state's dominant role in urban planning may therefore play a bigger role in affecting social equity than issues such as poverty and race when it comes to affecting the equity of public resource distribution. In contrast to Western societies where poor urban park access is widening the equity gap (Witten et al., 2003, Smoyer‐Tomic et al., 2004, Hewko et al., 2002), Shanghai's case reveals that although particular social groups are more susceptible to unequal treatment, it is possible to mitigate such effects. Planning regulations considerate of these 'patterns' of inequality can balance out some of the institutional and market inequalities.

The second potential explanation for the social equity in urban China is that rather than an entirely planned outcome by planning authorities, some social groups are unintentionally benefiting from the access to urban parks especially in the case of rural migrants. The GIS map reveals that the majority of high-high blocks of rural migrants are located in the inner city where most migrants are tenants living in physically deprived but cheap accommodations. However, given their inner city location, low-income neighbourhoods still enjoy access to urban parks that were either built during the planned economy era or were recently constructed as part of the wider inner city regeneration strategy of the Shanghai government (Shanghai Municipality 2001). Although rural migrants are not explicitly stated as target groups, they may be indirectly benefitting from the municipality urban green space plan.

However, the downside is that marginalised groups, especially rural migrants, are the first to be displaced due to redevelopment and are almost always unable to return to their former residence. With the gradual redevelopment of inner city Shanghai and the concentration migrant residents (Liao and Wong 2015), it remains to be seen whether rural migrants will continue to have good access to urban parks. Moreover, both the government (SADACA 2014; Shanghai Municipality 2001) and research (Wolch et al. 2014) acknowledge that the development of new public parks is insufficient and lagging behind the residential developments in Shanghai. Green space is increasingly becoming a commodity (Xiao et al. 2016) despite the government's efforts and policy initiatives such as reducing the walking distance to public green space in the city proper to 500m (MOHURD 2015). The consequence of China's transition to a market economy is that most green spaces are produced within private commodity estates communities (Xiao et al. 2016), which also explains our result of why affluent neighbourhoods do not have good access to public green space. The long-evolved nature of the socio-spatial patterns of historical Western cities indicates that green spaces have always tended to be either created by and for the better-off, or captured by them. It will be interesting to see what becomes of this progressive feature of China's 'design-and-build' cities as secondary property markets start to mature. Western experience and theory suggests that green spaces will help shape social geography over time as the more wealthy outbid the less wealthy, and capture the external value of popular urban facilities like parks.

Returning to the research question of whether Chinese cities are socially equitable in terms of access to urban facilities, the answer appears to be yes but not for long. This paper confirms existing studies to some extent as it shows that different social groups also have varying degrees of access to urban parks (Wolch et al., 2014, Talen 1997, 1998; Talen and Anselin 1998; Mlandenka 1989; Hasting 2007; Wolch et al., 2005; Sister et al., 2007). However, the difference lies in the fact that in the context of China, marginalised population groups that would normally live in low access areas tend to live in high park access neighbourhoods.

The implication of our study therefore is that urban planning needs to pay particular attention to the needs of marginalized groups. Our research indicates that it is the equitable planning approach from China's socialist era that has ensured the access to urban parks for low-income residents. Based on Shanghai's evidence, we thus recommend Chinese municipal governments to lead the construction of public parks and allow free public access but also explicitly state in their planning strategy that disadvantaged population groups should be prioritised. With regards to future studies on park access there are several aspects needing further research. Firstly, more understanding is needed in terms of the people's threshold distance preference on accessing urban parks. Xiao et al. (2016) assert that there is mitigating effect of club green space on urban public parks, which means many people are unwilling to access urban public park that requires long travel journey. Secondly, whilst our research revealed the equity of access to urban parks, more information is needed in regards to the quality of urban parks and whether the quality deteriorates in neighborhoods with a high portion of low-income residents. Finally, our measurement of accessibility is based on street network analysis and therefore only illuminates the physical aspects of accessibility. Future studies could improve our understanding of accessibility by incorporating alternative measures that take into account the psychological barriers of users (Byrne, 2012, Byrne and Wolch, 2009).

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List：

Tables:

Table 1. Descriptive Statistics

		Minimum	Maximum	Mean	Std. Deviation
Demographic characteristics	% age under 20	0.00	0.40	0.12	0.03
	% age 60 above	0.00	0.39	0.18	0.06
	% local city Hukou	0.00	58.88	0.86	1.97
	Unemployment rate	0.00	0.03	0.00	0.00
	%Marriage	0.00	1.00	0.62	0.12
Social spatial structure	Resident population density	6.00	37518.00	4242.37	2309.91
	Migration population density	0.00	3667.00	122.18	164.58
Social Economic status	%Commodity housing	0.00	11.00	0.28	0.36
	%Affordable housing	0.00	0.65	0.00	0.03
	%Welfare Housing	0.00	3.97	0.24	0.26
Access level to parks	park area within 1.6km (in m^2)	0.00	1125770.00	68000.84	100334.15
	park area within 3.2km (in m^2)	0.00	1371650.00	316282.50	253587.12

N=2730

Table 2: The estimation of social groups in high and low access census blocks

			Mann-Whitney U test	
Variable	High access Median	Low access Median	Z	*p*-value
	1.6 km covering range			
%Under age 20	10.01	11.84	-9.140	0.000***
%Above age 60	21.77	16.56	12.967	0.000***
%Hukou origin: local city	64.58	62.75	2.859	0.004***
Unemployment rate	0.22	0.227	-0.510	0.610
Resident population density	38800	25300	7.312	0.000***
Migration population density	727.00	556.19	4.432	0.000***
%Marriage	58.62	65.91	-7.698	0.000***
%Commodity housing	6.25	21.42	-4.005	0.000***
%Affordable housing	0.00	0.00	-0.274	0.784
%Welfare Housing	19.92	2.01	6.848	0.000***
	3.2 km covering range			
%Under age 20	10.37	12.06	-9.132	0.000***
%Above age 60	20.64	16.91	13.843	0.000***
%Hukou origin: local city	65.34	61.00	6.402	0.000***
Unemployment rate	0.250	0.223	2.081	0.037*
Resident population density	38050	27500	9.320	0.000***
Migration population density	712.64	553.21	6.681	0.000***
%Marriage	59.53	67.05	-11.153	0.000***
%Commodity housing	11.35	24.41	-3.232	0.001**
%Affordable housing	0.00	0.00	0.478	0.633
%Welfare Housing	23.82	0.82	9.567	0.000***

Notes: * p<0.05; **p<0.01; ***p<0.001