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ACCESS TO PUBLIC OPEN SPACE: IS DISTRIBUTION EQUITABLE ACROSS DIFFERENT SOCIO-ECONOMIC AREAS

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Abstract: During the past decade, the role of the built environment on physical activity has been well investigated by public health, transportation and urban design scholars and it has been shown that different aspects of the built environment can influence physical activity Public open spaces (POS) like parks have many health benefits and they can be important settings and destinations for having physical activity. Inequality in access to POS which may influence the amount of physical activity can be a reason for lower physical activity among deprived neighbourhoods. This paper aims to examine whether objective access to public open spaces (POS) like parks is equally across the different socio-economic status (SES) areas in the City of Melbourne. Objective access to POS was measured in network distance using geographic information systems (GIS) and area SES was obtained using the SEIFA (Socio-Economic Indexes for Areas) index. The results showed there was a significant difference in access to POS according to the SES areas. There was a significant negative correlation between the access to POS and the SES areas in which lower SES areas had poorer access to POS in comparison with the higher ones.

Keywords: Accessibility; public open space; physical activity; inequality; city

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INTRODUCTION

Physical activity has many health benefits like decreasing the risk of many chronic diseases (U.S. Department of Health and Human Services, 1996) and also can prevent obesity which can intensify a wide range of diseases such as certain types of cancers and type 2 diabetes (Sturm, 2007; Cohen, 2008). However, the rate of physical activity among most people is still insufficient.

During the past decade, there has been a special attention to the ecological model, which influences the whole population (rather than the individual-focused model), in health promotion issues. In relation to physical activity, the studies have focused on the role of the physical environment (Ball, 2006). There have been many studies especially in three fields (public health, transportation and urban design) examining the influence of the built environment on physical activity (Sallis *et al.*, 1997; Sallis *et al.*, 1998; Handy *et al.*, 2005; Li *et al.*, 2005; Frank *et al.*, 2005; Boarnet *et al.*, 2011; Sigmundová *et al.*, 2011; Sundquist *et al.*, 2011; Townshend & Lake, 2011).

Also, it has been shown that both individual and area level socio-economic status can influence the rate of physical activity among people (Janssen, 2006). There is a general assumption that people in disadvantages areas have poorer health condition even after controlling for individual characteristics and this leads to a broader idea which is that the built environment attributes promoting health are poorer in these disadvantaged areas (Macintyre, 2007). For example these areas suffer from lack of facilities, poor access to services, etc. Macintyre et al (2008, p. 901) describe this as “deprivation amplification”; that is, “a pattern by which a range of resources and facilities which might promote health are less common in poorer areas”. Thus, one reason for the differences in health among people living in advantaged and disadvantaged areas can be the inequity in facilities distribution.

Public open spaces like parks have various advantages like social, economic, environmental and health benefits (Bedimo-Rung *et al.*, 2005; Cohen *et al.*, 2007; Kaczynski & Henderson, 2008). These places can be used both as a setting for having physical activity and as destinations to walk to reach them (Bedimo-Rung *et al.*, 2005; Sugiyama *et al.*, 2010). Several studies showed that different aspects of POS like access to POS, their features, size can have an impact on the amount of physical activity by people (Giles-Corti *et al.*, 2005; Kaczynski *et al.*, 2008; Timperio *et al.*, 2008; Kaczynski *et al.*, 2009; Sugiyama *et al.*, 2010). Examining the aspects of POS across areas with different SES identifies how these aspects have been spatially distributed. Inequality in their distribution can be a possible reason for differentiation in the amount of physical activity among people across areas with different SES.

In an study in Metropolitan Melbourne, Timperio et al (2007) showed that there were no differences in the number or total area of POS across neighbourhood SES. This study did not support the general assumption that the availability (in terms of number and total area) of POS in poor neighbourhood SES is lower than high neighbourhood SES. In the same area as Timperio’s study, Crawford et al (2008) found that POSs in high neighbourhood SESs had more features (e.g. picnic tables, lighting, trees) that encourage physical activity in comparison with low ones. However, there were no differences in a few features like the number of playgrounds or the number of recreation facilities. Within this context, the current study aims to find whether there is a significant difference in access to POS among different SES areas in the City of Melbourne or not and if there is, what is its pattern.

METHODOLOGY

Public open space

POS includes a wide range of spaces like parks, playgrounds, and plazas. In this study, the Open Space 2002 dataset (produced by the Australian Research Centre for Urban Ecology) was used to identify POS across City of Melbourne areas. There are 14 types of POS classified by the level of access (no public access, restricted public access and full public access) (Australian Research Centre for Urban Ecology, 2003). In this study, only full public access POSs were considered within the study area **Fig. 1**.

Measuring access to POS

There are two general approaches in measuring access to facilities in the previous studies. The first one is the subjective approach which measures people’s perceptions of their access to facilities in their neighbourhood. This approach has been common in studies examining the associations of the built environment and health outcomes especially in the public health field (Transportation Research Board & Institute of Medicine, 2005; Butler *et al.*, 2011).

Within the second approach, the objective one, access to facilities is measured using spatial data obtained through field survey or remote sensing. Talen (2003, p. 183) defines at least five measurement approaches in objectively measuring access to facilities: “Container, Coverage, Minimum distance, Travel cost, Gravity”. For a review see: (Talen & Anselin, 1998; Talen, 2003).

In this paper, the minimum distance concept was used within the objective approach. Minimum distance is the distance between an origin and the nearest facility. The origin points in this research are the geometric centroids of parcels. The destination points

Fig. 1 Distribution of POS across the study area

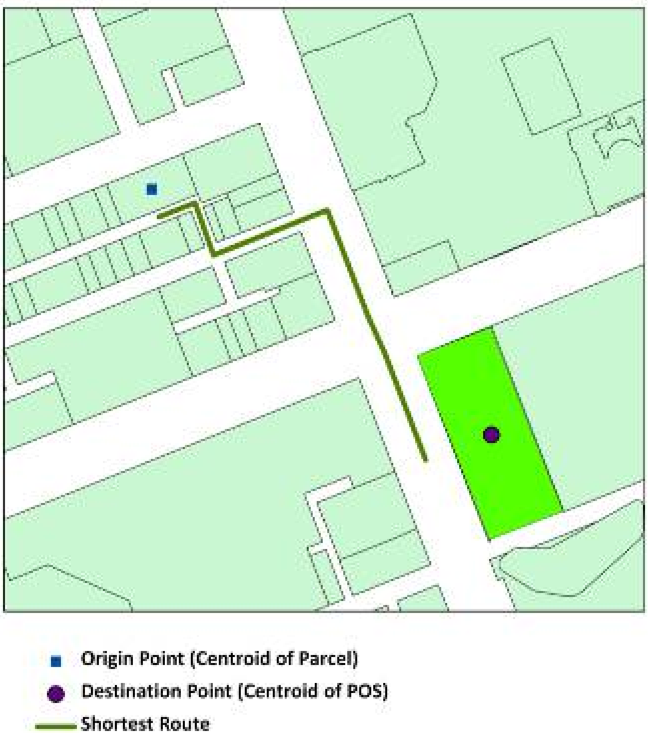

Fig. 2 Measuring objective access to POS

are the geometric centroids of POSs which are freely accessible. Network distance rather than Euclidian distance was used to calculate the distance between each origin and the nearest POS, since it has been shown that the former is more accurate (Nicholls, 2001; Witten *et al.*, 2003; Apparicio *et al.*, 2008; Comber *et al.*, 2008).

The datasets for parcels (VicMAP Property) and roads (VicMAP Transport) were provided under license from the Victorian Department of Sustainability and Environment to University of Melbourne (Department of Sustainability and Environment, 2009). **Figure 2** shows one example of measuring access to POS in this study.

Area SES

Census collection district (CCD) which includes average 200 dwellings in urban areas was used as a smallest geographical unit to assign SES level. The Index of Relative Socio-economic Advantage and Disadvantage from the Socio-Economic Indexes for Areas (SEIFA) (Australian Bureau of Statistics, 2008a) was used to capture the SES score for each CCD. This index includes income, education, employment, occupation, housing and other indicators of relative advantage or disadvantage. For example, an area can have a low score when it has "many households with low incomes, or many people in unskilled occupations; AND few households with high incomes, or few people in skilled occupations" (Australian Bureau of Statistics, 2008b, p. 11). All CCDs were assigned into SES quintiles which ranged from quintile 1 with lowest SES to quintile 5 with highest SES.

Statistical analysis

One-way analysis of variance (ANOVA), post hoc comparison and Spearman rank correlation analysis were used to examine whether there is a significant difference in access to POS across areas of SES or not. All statistical analysis was done using SPSS-PC for Windows 17 (SPSS Inc., Chicago, IL).

RESULTS

The City of Melbourne covers an area about 37.6 km^2 and a residential population about 71,360 at 2006 (Australian Bureau of Statistics, 2007).

Quintile 1 includes the smallest area about 17 percent of total area and the quintile 5 has about 23 percent of total area. Each of the other quintiles has about 20 percent of the total area. **Table 1** presents the result of one-way ANOVA and the post hoc test. The analysis confirms there was a significant difference in access to POS across different SES areas ($\rho \leq 0.01$).

Table 1 shows the access to the POS across SES quintiles. The access to POS in higher SES areas (quintiles 4 and 5) was better than in lower SES areas (quintiles 1 and 2); since the mean access is 309 m for the higher SES areas in comparison with 329 m for the lower ones. Quintile 4 has the best access to POS with the mean 270 m and the worst access is related to quintile 1 (lowest SES area) with the mean 359 m. The post hoc analysis shows both quintile 1 and quintile 4 have a significant difference with all other quintiles in access to POS ($\rho \leq 0.05$).

According to the Spearman correlation, there is a negative relationship between the access to POS and the quintile's number ($\rho \leq 0.01$). It means, access to POS gets worse moving from higher SES areas to lower ones.

DISCUSSION AND CONCLUSION

This study examined the access to POS across different SES areas in City of Melbourne to find out whether deprived areas have poorer access in comparison with non deprived ones or not. The findings showed that in this case, there is a significant difference in access to POS across different SES areas and lower SES areas had worse access to POS.

These results are consistent with the general assumption that people who live in low SES areas have poor access to the facilities and "it is often assumed that differential access to neighbourhood resources is one explanation for the observed gap in health between deprived and non-deprived neighbourhoods" (Pearce *et al.*, 2007, p. 349). Some studies confirm that deprived neighbourhoods have worse access to facilities in comparison with non-deprived ones (Guagliardo *et al.*, 2004; Larsen & Gilliland, 2008; Richardson *et al.*, 2010). However, there is contradictory evidence against accepting this general assumption. Some studies challenge the existence of such a disparity in the distribution of facilities, or even show that deprived neighbourhoods have better access to facilities (Pearce *et al.*, 2007; Lotfi & Koohsari, 2009; Smith *et al.*, 2010; Stroebele *et al.*, 2011).

In the case of distribution of POS in Metropolitan Melbourne, one previous study showed that availability of POS (number and total area) was equitable across areas (Timperio *et al.*, 2007) and another found that some features of POS were distributed differently according to different SES areas (Crawford *et al.*, 2008). Investigating another aspect of POS, the current study examined objective access, across SES areas (however, in a smaller geographical area than previous studies; City of Melbourne not Metropolitan). All these studies show different aspects of POS can differ according to SES areas and it is worthwhile to analyze all these aspects, as each one can have influence on health issues like promoting physical activity.

All these results can notify urban designers, planners and policy makers whether the facilities shown to influence health have been distributed equally among different SES areas. These analyses can be used as guidance for developing new plans for allocation or improvement of such facilities across different SES areas.

Table 1. Access to POS across SES areas

	Quintiles of socio-economic status (SES)					
	Quintile 1 (Lowest SES)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (Highest SES)	ρ - Value
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Access to POS ** (m^2)	358.67 (243)	298.71 (169)	309.95 (140)	270.02 (138)	308.96 (159)	.000*

* Significant trend $\rho \leq 0.01$; ** Significant differences between quintile 1 and other quintiles, and between quintile 4 and other quintiles (Tukey HCD post hoc test, $\rho \leq 0.05$).

This study had several limitations. It included only a part of Metropolitan Melbourne and also used the 2002 POS database, which should be considered in generalization of the results.

The subjective measure of access to POS was not included in this study. Lackey & Kaczynski (2009) found low associations among objective and subjective measures of access to the closest park. It is likely that the subjective measures of access which are derived from people's perceptions differ across area SES. Future studies can apply both types of measures which can present a more inclusive result.

In measuring access to POS, the centroids of POS were considered as destination points but, POS covers more than one point. Considering the centroids of POSs causes researchers to ignore the shape of POSs, which leads to the "inaccuracy" and "misrepresentation" of their service areas (Nicholls, 2001). To measure the distance to POS more accurately, the distance should be calculated from POS boundaries.

The street network data was used in this study as there were no available pedestrian network data. As it is supposed that POS will be considered as interesting destinations to walk to, street network data which is related to the car movement is not completely representative for pedestrian movement. These pedestrian missing data can cause an inaccuracy in calculating connectivity measures (Chin *et al.*, 2008).

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