A SPATIAL JUSTICE STUDY OF PEDESTRIAN-FRIENDLY ROUTES TO PRIVATELY OWNED PUBLIC OPEN SPACE IN HONG KONG

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ABSTRACT

Previous researchers have highlighted the uneven distribution of pubic open space (POS) in terms of both quality and quantity. Although the existence of this kind of inequality is well documented, the relationship between the spatial justice concerns of walkable routes to POS in compact city still lacks evidence. Meanwhile, a special type of POS – privately owned public open space (POPOS) has not been fully examined in terms of this research issue. This paper examines the pedestrian friendliness of routes to POPOS through the lens of spatial justice. We conduct a case study including three POPOS in Hong Kong. Walkability audit, field survey and GIS analysis are adopted to highlight the potential walkability inequality of streets around POPOS. The results show discernable differences in terms of the walking environment around POPOS and reveal the overall neighborhood walkability is not necessarily positively linked to community wealth in Hong Kong. Keywords: spatial justice, privately owned public open spaces, walkability, pedestrian friendliness, connectivity, gentrification, compact city.

INTRODUCTION

Walking, as one of the most natural ways of mobility, is vital to ensure spatial justice since it reflects the inseparable relationship between people's moving behavior and their ability to obtain urban resources (Carmona et al., 2012).

Living in a walkable community was validated as a useful catalyst for promoting active physical activities and public health. Recent international research has highlighted the important role the pedestrian-friendly streets near POS play in promoting spatial justice, community safety and lowering the risk of non-communicable diseases and overweight (Su et al., 2017) (Rigolon et al., 2018). Walkable routes to POS offer venues for a relaxing experience that celebrates less air pollution. The safe walkable environments create better settings for unplanned social contact among local residents and therefore lower the risk of social isolation and exclusion (Nikšič, 2017).

Public Open Space (POS) located within walking distance facilitates its' attainability and affordability for all. As growing attention goes to issues concerning socioeconomics-based inequality, uneven distribution and mismatch of POS recently, researchers have made their efforts to scrutinize neighborhood walkability through the lens of spatial justice (Riggs, 2016) (Jian et al., 2020). Review of the recent evidence suggests an inequitable allocation of walkable routes and points to a positive association between walkability and community wealth. Wealthier communities usually enjoy more walkable routes to POS while pedestrian friendliness is compromised in less

affluent areas (Koschinsky et al., 2017). Living in an "un-walkable" environment can be interpreted as an expression of injustice since it refers to less physical activity and overweight, and increased exposure to traffic-related air pollution (Simons et al., 2014).

Under intensified urbanization, open spaces tend to be manipulated and eroded by local government and private interests, especially those privately-owned public open spaces (POPOS), to gain interests and reduce administration costs. Therefore, walkable routes to POS represent an important dimension of spatial justice that could affect people's right to enjoy the city and reflect an essential control over public places, where social interactions and physical exercises that support healthy life-styles occur (Boone et al., 2009) (Jian et al., 2020). However, little research has addressed this issue in the context of compact cities where the spatial justice of POS is more important due to the narrow living spaces.

This study aims to fill the gap by examining the spatial justice issue pertaining to the pedestrian-friendly routes to urban POS, POPOS in particular, in a high-rise, high-density compact urban form with many urban renewal cases. Based on the previous work, we hypothesize that for POPOS located in wealthier districts, the routes to or surround it would have a higher level of pedestrian friendliness. Following this introduction, the remainder of this paper consists of four sections. We first review the literature on walkability and spatial justice. The methodology is then presented, including the case selection and methods adopted to measure the walkability of routes in POPOS catchments. The final parts present the results and conclusions.

WALKABILITY AND SPATIAL JUSTICE

Researchers have proposed several definitions of walkability. As a summarization, walkability is defined in this study as the capability of the built environment to support walking behavior, for the purpose of exercise, recreation, travel, social contact, or to access services, especially POS (Su et al., 2017). It is an aggregate idea that considers the objective facilities that support walking, as well as the subjective walking experience, with an emphasize on people's safety and comfort while walking (Ariffin and Zahari, 2013). The concept in this paper stresses the pedestrian friendliness of the streets to or around the POS.

Walkability demonstrates gradient variation among different communities (Su et al., 2017). Relevant empirical findings have provided several insights about the social injustice in walkability at the neighborhood level. In the western context, the possibilities of ethnic minorities to afford to live in walkable districts are typically lower compared to their white counterparts (Riggs, 2016) (Rigolon et al., 2018). The minorities-concentrated neighborhoods are usually far from the downtown and more scattered and atomized with high road density (Cowie et al., 2016). In a typical big city of China, Shenzhen's communities are revealed to have lower levels of walkability if the proportions of child residents are higher or if most of their residents are socioeconomically disadvantaged (Su et al., 2017). Unfortunately, these vulnerable groups live in less walkable areas are the same group of people who demand walkability to reach POS resources most.

A group of scholars illuminated the way the walkable urban form, especially the network configuration facilitates residents' propensity for walking. As expected, the most obvious outcome of a well-connected network is the good accessibility and walkability in cities (Zhang et al., 2020). Nagel et al. (2008) objectively measured parameters relevant to street network connectivity to simulate the built environment and discussed their relationships with walking activities. The parameters include, but not limited to the percentage of different volume streets, Percentage of

sidewalk coverage, Number of intersections, and Euclidian distance to the nearest park. The results indicated that the total walking time participants reported is mathematically related to the ratio of high-volume and low-volume streets, which reflect the street connectivity and road hierarchy, in the community (Boessen et al., 2018).

Apart from improving overall accessibility and walkability, high street connectivity also has the potential to bridging trust and influencing patterns of social ties. The walkable environment and the shorter distance between neighbors, provided by the well-connected street network, made it convenient for people to go out, have pedestrian trips (Zhang et al., 2020), and increase the likelihood of passive and informal contacts and social interaction (Cabrera and Najarian, 2015) (Boessen et al., 2018), as well as form a sense of belonging (Wood et al., 2012). On the country, people who live in a less connected area tend to spend more time traveling from home to their destinations, thus, they rely more on motor vehicles, or communicating online instead of spending time with their friends (Putnam, 2000) (Nabil and Eldayem, 2015).

The above-mentioned research studied the merits of promoting urban walkability and validated a need to create walkable urban form and further create a more just city. In terms of the walkability determinants, the principles previous research stressed can be categorized into four dimensions namely accessibility, connectivity, suitability and perception (Su et al., 2017) (Moura et al., 2017) (Koschinsky et al., 2017). Among which, accessibility and connectivity are assessed to demonstrate the convenience to reach destinations, usually at the level of the neighborhood, while suitability and perception are stressed when describing the quality of the pedestrian environment at the segment level, such as the safe walking conditions, air quality and pedestrian security (Su et al., 2017) (Koschinsky et al., 2017).

Variables	*A1. Sidewalk smoothness*	*A2. Sidewalk–road buffer*	*A3. Sidewalk width*	*A4. Sidewalk connectivity*	*A5. Street lights*
Scoring System	*0: Poor (uneven surface or slope);* *0.5: Fair (relatively even surface, Concrete);* *1: Good (even surface, Paving bricks);*	*0: Poor (no buffer presence);* *0.5 Fair (less than 50%);* *1: Good (more than 50%);*	*0: < 1.5 meters;* *0.5: 1.5 - 2.5 meters;* *1: > 2.5 meters;*	*0: Low;* *0.5: Middle;* *1: High;*	*0: No lighting;* *0.5: Road-oriented lighting;* *1: Pedestrian-oriented lighting*
Variables	*A6. Cleanliness and maintenance*	*A7. Façade diversity*	*A8. Rest Area*	*A9. Road Car Parking*	*A10. Shelter Provided*
Scoring System	*0: Poor;* *0.5: Fair (litter but no graffiti or garbage);* *1: Good (no litter, graffiti, or garbage)*	*0: Poor (no or single function, enclosing walls);* *0.5: Fair (single function, not very ornate);* *1: Good (multiple function, diverse facade);*	*0: None* *0.5: Average (one area presented)* *1: Good (more than one area presented)*	*0: None;* *1: Parallel;*	*0: Poor (No or limited shelter provided);* *0.5: Fair (at least 50% shelter provided);* *1: Good (Shelter can cover most of the street);*

Figure 1. Pedestrian Friendliness Index (PFI)

Yet, research methodologies and frameworks proposed for walkability assessment in different parts of the world may not well proxy the situation in Hong Kong, a compact city with unique urban morphological characteristics and social traditions. Therefore, in this study, we adopt the framework developed by Rigolon et al. (2018) and Ng et al. (2016) which pertaining to the walkability assessment in Hong Kong context, and deliberately chose to measure some key factors that fit our objectives. Figure 1 presents the modified framework and scoring system named Pedestrian Friendliness Index (PFI).

METHODOLOGY

As a densely populated city, Hong Kong has been suffering long the chronic shortage of easily accessible POS. The compact morphology leaves the city dwellers little chance to have instant contact with open space. We focus our research on POPOS and the areas they serve and select the neighborhood samples from POPOS in Hong Kong urban areas, namely Kowloon peninsula and Hong Kong island. More specifically, Trinity tower is a competitive case to examine the walkability to POS for it is located in a low-income district that already suffers from the shortage of POS, while K11 in Tsim Sha Tsui and The Avenue in Wan Chai stands for small shopping malls that provide different POS atmosphere and publicness.

A street network of Hong Kong is prepared to identify road segments located within 10-minute walking distance to the study POPOS (e.g., a street entering or surrounding the POS). The methods include the road network connectivity analysis in Geographic Information Systems environment, and the assessment of pedestrian friendliness within the catchment by adopting the modified framework. Socio-demographic data within the service areas is prepared (Figure 2).

	Primary School or Below	*Middle School*	*University or above*	*Male*	*Female*	*Total Population*	*POPOS Area (ft^2)*	*POPOS Area per person (ft^2)*	*Median Monthly Domestic Household Income (HKD)*
Trinity Tower	*37%*	*42%*	*21%*	*47%*	*53%*	*140218*	*6243*	*0.04*	*20245*
K11	*22%*	*39%*	*39%*	*46%*	*54%*	*20602*	*12917*	*0.63*	*28393*
The Avenue	*25%*	*34%*	*41%*	*46%*	*53%*	*50089*	*35747*	*0.71*	*33027*

Figure 2 Socio-Demographic data in study areas

The analysis consists of three objective measures, intersection density (ID), Link Node Ratio (LNR) and Pedestrian Route Directness (PRD), for the unaffordable distance and time are two key barriers for walking behavior (Randall and Baetz, 2001) (Chin et al., 2008). Respectively, ID measures the number of true intersections per square kilometer (Park and Guldmann, 2020); LNR refers to the number of road segments divided by the number of nodes (road intersections and cul-de-sacs), with a higher value indicating better connectivity; PRD equals to the ratio of actual route distance traveled along the network to a straight-line distance between two selected points (origin and destination). A higher value represents higher route redundancy and diversity but lower level of connectivity and permeability (Chin et al., 2008). Notably, these three indexes are calculated for all POPOS within the research catchment.

All street segments within the analysis areas are audited by checking Google Earth and Google Street View (September 2019) (Rigolon et al., 2018), as well as field surveys. The 10 variables in Table 1 are assessed and standardized with three values 0, 0.5 and 1, a higher value indicating higher walkability. Each variable is weighted equally towards the final score. Every author conducts his or her own auditing process and then compare all assessment results. In total, 69 roads (including Avenue, Street, Road, and Lane) are examined. The conflict results are finalized and validated by group discussion and field survey to maintain consistency of the final score. The quantitative data were standardized and outputted into Smart-PLS for Structural Equation Modelling (SEM) analysis.

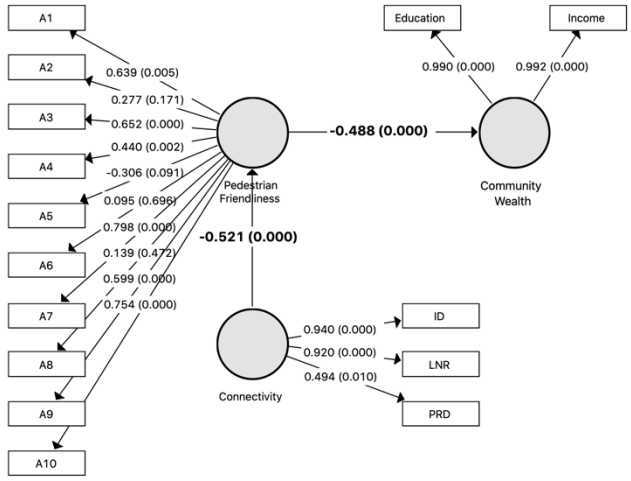

Figure 3. SEM Analysis Results

The extreme geographical condition in Hong Kong generates a different scenario of the relationship between walkability and community wealth: the impact of pedestrian friendliness on community wealth, and the objectively calculated connectivity values on pedestrian friendliness are both negative (Figure 3). This is inconsistent with our hypothesis and the dominant view which claims a positive relationship between these two sets of concepts (Rigolon et al., 2018).

Although the three cases are POPOS with relatively high patronage, they represent different walkable urban form around. Generally speaking, routes conditions within the service area of The Avenue vary significantly (i.e. St. Deviation = 1.92). For example, Queen's Road East scores 9 and ranks first in terms of pedestrian friendliness, while King Sing Street and Triangle Street have unsatisfactory performance, boring façade and dirty roads and only score 1. Streets around K11 show smaller differences with the lowest St. Deviation value (i.e. 1.24) (Figure 4).

Figure 4. PFI score for representative streets

Trinity Tower is located at an economically disadvantaged community, Sham Shui Po. The highest PRD value indicates its grid network layout. Despite the less-than-ideal cleanliness and maintenance conditions, the roads here enjoy a relatively good sidewalk width, all of the study routes are at least 1.5 meters wide with old but diverse street façade. The smooth and flat roads positively contribute to the pedestrian friendliness. Small rest areas are distributed along some streets.

By contrast, Wan Chai is endowed with more complex terrain, therefore generate more slops than the other two cases. Overall, the majority of the study routes have relatively narrower sidewalks with fewer street car parking, very few sittable areas appear along the streets. In terms of objectively measured connectivity, The Avenue has the highest ID value among the three cases, yet, its LNR is also higher than the other two cases. This might reveal the fact that there exist more dense short streets in Wan Chai, and the audit results show a low score of pedestrian friendliness for them. Meanwhile, Wan Chai has more cul-de-sacs, most of them are single function, even have no functional façade (Figure 4). These are negatively associated with the overall pedestrian friendliness.

Notably, The Avenue is a community that is highly gentrified. Benefited by its geographical location and urban regeneration of Lee Tung Street, the housing price in this district continued to rise. This has led to the relocation of the indigenous people and the in-migration of the middle and upper classes, raise the average income within the study catchment area as a consequence. However, the appearance of some luxury communities did not promote the development of the whole area. The developers devoted a lot to improve the quality of the streets that would directly benefit the real estate markets. The other old streets remain to be neglected, lack of maintenance and narrow.

CONCLUSIONS

Pedestrian friendliness of the built environment has consequences on individuals' right to POS within the community. This study contributes to the spatial justice research on POPOS access by re-examining the relationship between pedestrian-friendly routes and community wealth in POPOS catchments in compact cities. We produce evidence from Hong Kong about inequities and variation of routes' pedestrian friendliness and find that neighborhood walkability is not necessarily positively linked to community wealth. People living in the old, less-affluent district enjoy a good overall level of walkability with wider smooth sidewalk, dynamic street façade, while in the wealthier community, complex terrain and gentrification caused the walking environment differs sharply, some residents may experience some difficulty in enjoying their trip to the nearest POS on foot. Our findings highlight the necessity to be aware of the gentrified districts where might exist unevenness with respect to the allocation of walkable resources and spatial segregation. Urban planning strategies should be employed to achieve a spatial justice oriented walkable community.

REFERENCES

ARIFFIN, R. N. R. & ZAHARI, R. K. 2013. Perceptions of the urban walking environments. *Procedia-Social and Behavioral Sciences,* 105**,** 589-597.

BOESSEN, A., HIPP, J. R., BUTTS, C. T., NAGLE, N. N., SMITH, E. J. J. E., ANALYTICS, P. B. U. & SCIENCE, C. 2018. The built environment, spatial scale, and social networks: Do land uses matter for personal network structure? 45**,** 400-416.

BOONE, C. G., BUCKLEY, G. L., GROVE, J. M. & SISTER, C. 2009. Parks and people: An environmental justice inquiry in Baltimore, Maryland. *Annals of the Association of American Geographers,* 99**,** 767-787.

CABRERA, J. F. & NAJARIAN, J. C. 2015. How the built environment shapes spatial bridging ties and social capital. *Environment and Behavior,* 47**,** 239-267.

CARMONA, M., HEATH, T., OC, T. & TIESDELL, S. 2012. *Public places-Urban spaces*, Routledge.

CHIN, G. K., VAN NIEL, K. P., GILES-CORTI, B. & KNUIMAN, M. 2008. Accessibility and connectivity in physical activity studies: The impact of missing pedestrian data. *Preventive medicine,* 46**,** 41-45.

COWIE, C. T., DING, D., ROLFE, M. I., MAYNE, D. J., JALALUDIN, B., BAUMAN, A. & MORGAN, G. G. 2016. Neighbourhood walkability, road density and socio-economic status in Sydney, Australia. *Environmental health,* 15**,** 58.

JIAN, I. Y., LUO, J. & CHAN, E. H. 2020. Spatial justice in public open space planning: Accessibility and inclusivity. *Habitat International***,** 102122.

KOSCHINSKY, J., TALEN, E., ALFONZO, M. & LEE, S. 2017. How walkable is Walker's paradise? *Environment and Planning B: Urban Analytics and City Science,* 44**,** 343-363.

MOURA, F., CAMBRA, P. & GONÇALVES, A. B. 2017. Measuring walkability for distinct pedestrian groups with a participatory assessment method: A case study in Lisbon. *Landscape and Urban Planning,* 157**,** 282-296.

NABIL, N. A. & ELDAYEM, G. E. A. 2015. Influence of mixed land-use on realizing the social capital. *HBRC Journal,* 11**,** 285-298.

NAGEL, C. L., CARLSON, N. E., BOSWORTH, M. & MICHAEL, Y. L. 2008. The relation between neighborhood built environment and walking activity among older adults. *American journal of epidemiology,* 168**,** 461-468.

NG, S., LAI, C., LIAO, P., LAO, M., LAU, W., GOVADA, S. & SPRUIJT, W. 2016. Measuring and improving walkability in Hong Kong. *Civic Exchange and UDP International*.

NIKŠIČ, M. 2017. Is a Walkable Place a Just Place? The Case of Ljubljana. *Built Environment,* 43**,** 214-235.

PARK, Y. & GULDMANN, J.-M. 2020. Understanding disparities in community green accessibility under alternative green measures: A metropolitan-wide analysis of Columbus, Ohio, and Atlanta, Georgia. *Landscape and Urban Planning,* 200**,** 103806.

PUTNAM, R. D. 2000. Bowling alone: America's declining social capital. *Culture and politics*. Springer.

RANDALL, T. A. & BAETZ, B. W. 2001. Evaluating pedestrian connectivity for suburban sustainability. *Journal of Urban Planning and Development,* 127**,** 1-15.

RIGGS, W. 2016. Inclusively walkable: exploring the equity of walkable housing in the San Francisco Bay Area. *Local Environment,* 21**,** 527-554.

RIGOLON, A., TOKER, Z. & GASPARIAN, N. 2018. Who has more walkable routes to parks? An environmental justice study of Safe Routes to Parks in neighborhoods of Los Angeles. *Journal of Urban Affairs,* 40**,** 576-591.

SIMONS, E., DELL, S., MOINEDDIN, R. & TO, T. Longitudinal associations between neighbourhood walkability and incident childhood asthma. Allergy, Asthma & Clinical Immunology, 2014. BioMed Central, A8.

SU, S., PI, J., XIE, H., CAI, Z. & WENG, M. 2017. Community deprivation, walkability, and public health: Highlighting the social inequalities in land use planning for health promotion. *Land Use Policy,* 67**,** 315-326.

WOOD, L., GILES-CORTI, B. & BULSARA, M. 2012. Streets apart: Does social capital vary with neighbourhood design? *Urban Studies Research,* 2012.

ZHANG, X., MELBOURNE, S., SARKAR, C., CHIARADIA, A. & WEBSTER, C. 2020. Effects of green space on walking: Does size, shape and density matter? *Urban Studies***,** 0042098020902739.

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