Contribution of Urban Destinations to Physical Activity:
Insight From Nationwide Smartphone Trajectory Data in China

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ABSTRACT

Past studies have investigated the association between the built environment and active lifestyle, but the environmental exposure in most of these studies was measured in residential settings with predefined boundaries. In this study, the authors investigated the relationship between destinations in cities and walking behaviors in national and provincial capital cities in China based on a nationwide smartphone dataset. They identified destinations that were strongly and consistently associated with walking behaviors based on geographic information systems (GIS) spatial analysis. Results from this study suggest that certain components, especially parks, rivers, running tracks, of the built environment, were positively associated with walking behaviors. Parks were consistently associated with more frequent walking behaviors while rivers were associated with longer walking trajectories. Findings from this study help better understand to what extent urban destinations influence physical activities and support evidence-based urban planning and health promotion in cities.

KEYWORDS

INTRODUCTION

Engaging in regular physical activity (PA) has substantial health benefits (Rhodes et al., 2017), especially in reducing the risk factors for chronic diseases such as type II diabetes and cardiovascular disease (Koohsari et al., 2013; Lear et al., 2017). In addition to health benefits, being physically active can also reduce the burden of health care costs and improve quality of life (See our published commentary for more details, Li, 2014). Among all the physical activities, walking is a major form of PA promotion initiative for adults due to its convenience and high acceptance rate (Lee and Buchner, 2008). Despite these benefits, overall engagement in walking or in general all forms of active lifestyle has been declining over the last few decades (Brownson et al., 2005; Koohsari et al., 2013; Farooq et

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al., 2018). Fortunately, prior researches also suggested that a well-designed built environment, as a promising means of health intervention instrument, has high potentials in promoting active lifestyles (Sallis et al., 2016; Ding & Gebel, 2012; Sallis et al., 2018). A variety of studies suggested that the characteristics of the built environment were associated with active behaviors (Hinckson et al., 2017). For instance, major city destinations such as shops, food outlets, and parks could be important attractive factors to PA (Lee and Moudon, 2004).

Although some studies have shown that the built environment could encourage an active lifestyle, other studies have reported inconsistent and sometimes contradictory results (Barnett et al., 2017). For instance, Oyeyemi et al. (2013) reported inconsistent associations between street connectivity and PA outcomes compared to their previous studies. These inconsistencies and contradictions stem partly from the challenges of collecting valid and reliable data regarding the environmental features of the locations where people walk (Troped et al., 2010). For instance, many studies assumed activity happened within a predefined area and associate the travel behaviors with the environmental features in those predefined units (Mason et al., 2018). In this way, researchers were unable to capture the much broader context where physical activity occurs. To overcome this limitation, recent studies have used the global positioning systems (GPS) to measure walking locations more objectively as opposed to relying on traditional self-reported activities or travel diaries. However, the number of participants and the sampled locations were usually small because of logistical restrictions. This challenge prevents us from comprehensively understanding the influence of built environments on walking behaviors in large study areas such as cities, and thereby limits the potential to use research results to guide evidence-based urban planning to improve population health.

Furthermore, studies exploring the built environment and physical activities mostly concentrated in America and Europe (Ding et al., 2011), much fewer studies have investigated the patterns in Chinese cities. China has been undergoing an unprecedented urbanization process since the early 1990s (Chen et al., 2013) and such a process has been reported to be contributing to a declining pattern of physical activity in the Chinese population (Ng et al., 2009, Su et al., 2014). In addition, the built environment in Chinese cities is very different from those in other countries, such as city form and compactness (Su et al., 2014). Thus, a better understanding of how and to what extent different urban environmental features influence physical activities can help promote an active lifestyle in Chinese cities.

To address the above research gaps, we investigate the impacts of urban destinations on walking behaviors in national and provincial capital cities in China based on a nationwide smartphone dataset. We aimed to detect the destinations that were strongly and consistently associated with walking behaviors. We were also interested in discovering destinations that attract habitual walking behaviors, intending to identify environmental features that foster regular walking. In the following section, we began with reviewing related studies and proposing specific research questions we aimed to address.

RELATED STUDIES

Among the four domains of PA, namely leisure, active transportation, personal care, and work activities (Armstrong and Bull 2006), walking for leisure is the most common choice in many countries (Millward et al., 2013). As a result, walking behaviors have become one of the research focus in many areas including public health, geography, and kinesiology. These past studies have commonly used predefined boundaries such as census units (e.g., census tracts in the US) (Koohsari et al., 2013; Villeneuve et al., 2018) and various sized buffers around points of interest (POIs) (e.g., home location, da Silva et al., 2017) to examine the walking environment. However, neither the boundary approach nor the buffering approach could accurately capture the environment where activities took place. PAs are more likely to happen in a larger physical space than just inside a residential neighborhood. More importantly, the environmental features where the physical activity took place often differ from those in residential neighborhoods (Troped et al., 2010; Zenk et al., 2011). This mismatch between the measured environmental features using either the boundary or the buffering approach and the actual

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