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How the built environment affects change in older people's physical activity: A mixed- methods approach using longitudinal health survey data in urban China

Peiling Zhou [a, *], Sue C. Grady [b], Guo Chen [b]

[a] Department of Geography, Environment, and Spatial Sciences, Michigan State University, 673 Auditorium Rd., Rm. 203, East Lansing, MI 48824, USA
[b] Department of Geography, Environment, and Spatial Sciences, Michigan State University, 673 Auditorium Rd., Rm. 207, East Lansing, MI 48824, USA

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ABSTRACT

Although the general population in China is physically active, only 45% of older adults meet the World Health Organization's recommendation for weekly moderate-to-vigorous exercise, to achieve health benefits. This percentage is even lower (9.8%) in urban China. It is, therefore, important to understand the pathways by which physical activity behaviors are impacted by the built environment. This study utilized a mixed methods approach—interviews (n = 42) and longitudinal (2010–2015) health survey data (n = 3094) for older people residing in three neighborhoods in Huainan, a mid-sized city in Anhui Province, central eastern China. First, a content analysis of interview data was used to identify individual and built environment factors (motivators and barriers) that impacted physical activity within older people's activity spaces. Second, a multilevel path analysis was conducted using the health survey data to demonstrate the pathways by which these motivators and barriers contributed to the initiation, regulation, and maintenance of physical activity. This study found (a) that the liveliness of an apartment building and its proximity to functional spaces (fast-food stores, farmer's markets, supermarkets, pharmacies, schools, hospitals, PA facilities and natural and man-made water bodies) were important factors in attracting sedentary older people to initiate physical activity; (b) the social networks of apartment neighbors helped to initiate, regulate, and maintain physical activity; and housing closeness to functional spaces was important in maintaining physical activity, particularly for those older people with chronic diseases. To increase older people's overall physical activity, future interventions should focus on residential form and access to functional spaces, prior to investing in large-scale urban design interventions.

1. Introduction

The global population of older adults is estimated to increase from 900 million in 2015 to 2.1 billion in 2050, with 30 percent of this increase attributed to the growing older population in China (World Health Organization (WHO), 2016). Hallal et al. (2012) reported that globally, older people are the least active population group. In China, only 45% of older adults meet the WHO recommendation for 150 weekly minutes of moderate-to-vigorous physical activity (PA) to achieve health benefits (Hallal et al., 2012). This percentage is even lower (9.8%) in urban China (Muntner et al., 2005; WHO, 2010), which may in part explain the rising prevalence of chronic diseases in this population (Wang, 2015; WHO, 2006; Xu et al., 2013; Yang et al., 2012). Physical inactivity can be an important cause of chronic disease morbidity among older adults (Bauman et al., 2012), which also adversely affects life quality, community-based aging and ultimately increases social and economic burdens. Physical inactivity among older people in China and the rising health concerns in this population have prompted researchers and public health officials to identify key factors and generate new policies and interventions to promote PA among older adults, particularly in urban areas.

At the individual level, increasing age and chronic diseases can be key barriers to initiate and maintain PA (Brawley et al., 2003). As age increases, people become less physically active contributing to the onset of chronic disease. At the community level, the physical

* Corresponding author.
E-mail addresses: zhoupeil@msu.edu (P. Zhou), gradys@msu.edu (S.C. Grady), guochen@msu.edu (G. Chen).

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infrastructure and how older people perceive the built environment can also impact PA (Berke et al., 2007; Ding and Gebel, 2012; Kerr et al., 2012; Sundquist et al., 2011). Within a Social Ecological Framework (Centers for Disease Control and Prevention, 2017), both social and physical aspects of the built environment are considered to be important correlates of PA among older populations (Cunningham and Michael, 2004; King et al., 2011). In terms of the physical aspects of the built environment, features such as land use mix (Li et al., 2005), walkability (Marquet and Miralles-Guasch, 2015) and density of services (Subramanian et al., 2006) are known to promote PA, but can take decades to redesign and reconstruct the urban infrastructure. As older people walk in and out of their apartments every day, their social interactions with neighbors, as well as the physical aspects of their local community have the potential to influence their PA. Older people in urban China generally have control over their choice of housing (Zimring et al., 2005) with most older people living in apartment buildings, increasing their potential for social interaction with their neighbors, which can influence their PA.

However, while there is the potential of altering PA through housing, community and urban infrastructure, it remains unknown whether an improved built environment will encourage sedentary older people to initiate PA or simply provide more convenience to those who are already physically active (Rosenberg, 2016; Schwarzer, 2008). In addition to initiating PA, there may be other challenges to promoting PA to meet the WHO guidelines for maintaining such behaviors (Van Cauwenberg et al., 2011). These challenges, also referred to as PA barriers, are more likely to restrict older compared to younger people's daily activities. Triggers to initiate, regulate and maintain healthy behaviors, including PA, have been studied using Stages of Behavior Change Models, such as the Transtheoretical Model (Marshall and Biddle, 2001) and the Precaution Adoption Process Model (Schwarzer, 2008). However, relatively few studies have examined how built environment interventions impact PA change (McNeill et al., 2006; Schwarzer, 2008). Moreover, less is known about the effectiveness of social interaction and physical built environmental interventions on PA in older populations (Brawley et al., 2003), particularly among the growing and understudied older population experiencing a rise in chronic disease prevalence in China (Ying et al., 2015). The purpose of this study, therefore, is to improve our understanding of how individual, social, and physical aspects of the built environment can motivate older people to initiate, regulate, and maintain their PA.

2. Data and methods

2.1. Study area and population

This study was conducted in a mid-sized city, Huainan, in Anhui Province in central eastern China. Huainan had a population of 3,456,000 in 2016, of which 12.9% were older adults (65 + years) (National Bureau of Statistics, 2017). Huainan is one of the 120 most rapidly growing industrial cities in China - a microcosm of the nation's rapid demographic transition, characterized by a growing older population, limited healthcare services, and a rise in chronic disease morbidity and related mortality (Wang, 2008). Like other industrial mid-sized cities in China, Huainan is different from large global cities as it remains walker-friendly with access to functional spaces from most residential locations. In this research, three contiguous neighborhoods in Huainan were selected to study because of research access to outpatient longitudinal health survey records. The older people in these neighborhoods were also open to talking with researchers about their activity spaces and community social interactions.

2.2. Study design

This study combined the Social Ecological Model and the Stages of Behavior Change Model to investigate intervention pathways by which characteristics of the individual and their social and physical built environments contributed to the initiation, regulation, and maintenance of PA. From the social ecological perspective, the social and physical aspects of the built environment are examined in order to recommend interventions in community engagement and neighborhood design. From the stages of behavior change perspective, three stages of PA (i.e., the initiation, regulation, and maintenance of PA) are studied in order to identify features of the social and built environments that promote PA at each of these change levels.

This study applied a mixed-methods approach in data collection and the analytical process. In the qualitative phase, older adults were interviewed about their PA and content analysis was used to evaluate their responses. Subsequently, their activity spaces were mapped to show the approximate residential locations in relation to outdoor functional-PA spaces and PA practice locations in the built environment. Information gained in regards to the motivators and barriers for PA were used to build a conceptual model by which to test factors associated with the initiation, regulation, and maintenance of PA from a population perspective. In the quantitative phase, six years of longitudinal health survey records comprising 97% of older residents were obtained from the hospital serving the three neighborhoods. Multilevel path analyses were conducted to estimate the associations between individual, social, and physical built environment characteristics and changes in PA, including the mediating effects of chronic diseases and physically active neighbors. In addition, random slope path analysis was used to examine the moderating effects of age in these relationships (Rouquette et al., 2015). The process of mixed-methods integration is shown in Fig. 1 and described more fully below. Finally, the residential locations of sedentary older adults were identified and mapped to show where to begin community interventions. To protect the confidentiality of all the participants, all identifiable information was removed from the final datasets. The qualitative

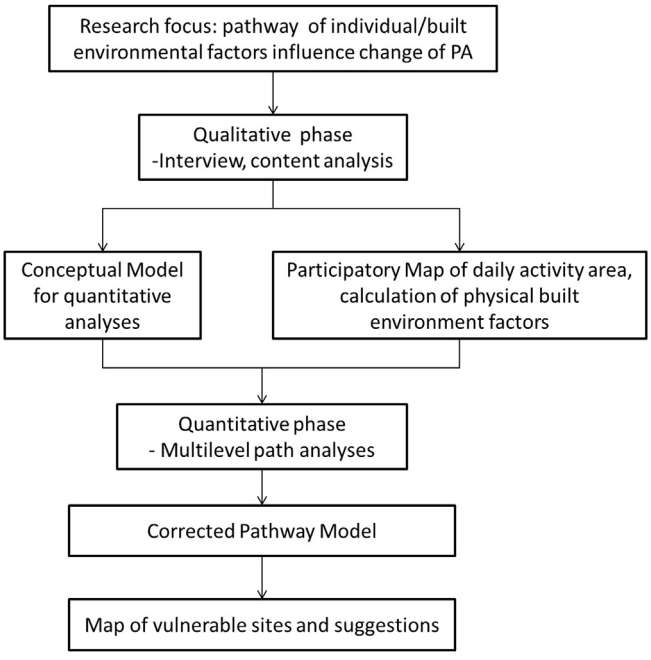

Fig. 1. The process of mixed-methods integration.