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Review Article

Built environmental correlates of physical activity in China: A review

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ABSTRACT

Objective. China faces growing levels of physical inactivity and obesity, associated with increasing urbanization and changing lifestyles in recent years. China is expanding its cities to accommodate a growing urban population. This paper identifies built environment factors that are associated with physical activity in China. Findings can inform urban design and development in China to support increased physical activity.

Methods. This paper is modeled on a review of built environment correlates of walking by Saelens and Handy (2008). Saelens and Handy reviewed research in developed countries. The present paper reviews 42 empirical studies that were conducted in China and were published between 2006 and 2014.

Results. Results discuss the association of built environment features and physical activity for transportation, recreation and work. Studies focus on adults and on major cities. Data on the built environment is typically self-reported. Strongest evidence was found for the positive association of physical activity with proximal non-residential locations, pedestrian infrastructure, aesthetics, and non-park physical activity facilities, and for the negative association of physical activity with urban residence. In terms of physical activity for transportation, evidence is strongest for associations between physical activity for transportation and proximal non-residential locations.

Conclusion. More research is needed on the built environment and physical activity, especially including research on significant features of Chinese cities, such as air pollution, high density levels, traffic safety, and others. Research on associations between built environment features and physical activity should consider the specific social and built environment contexts of Chinese cities.

Contents

1. Introduction

Rising obesity, declining physical activity, and growing rates of chronic disease are major concerns in China and in other developing countries. According to the World Health Organization (WHO) (2015), 36.2% of adults in China are now overweight and 5.9% are obese. Nearly 80% of deaths in China are attributable to noncommunicable (or chronic) disease (World Health Organization, 2005). Between 1991 and 2006, the average weekly rate of physical activity dropped by approximately 32% among adults (Ng et al., 2009). For men, self-reported occupational, domestic, transportation, and leisure physical activity, fell from 350 MET (metabolic equivalent) hours per week in 1997 to 253 MET hours per week in 2006. Women's physical activity declined from 390 MET hours per week in 1996 to 246 MET hours in 2006 (Ng et al.,

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2009). Insufficient physical activity is a leading contributor to diseases such as diabetes, cancer and cardiovascular disease (WHO, 2015).

To reduce obesity and overweight and to combat noncommunicable diseases, the World Health Organization advocates strategies that target entire populations, including the design of environments to promote physical activity for transportation and recreation as part of everyday life (WHO, 2015), or "active living." Historically, research on active living has examined developed countries, especially the USA and Canada, Australia, European countries, and Japan. Active living research from developed countries is not necessarily generalizable to developing countries such as China, where the cultural context and the built environment may differ (Sallis, 2011). Indeed, physical activity in China is shaped by specific built environment factors and also by Chinese cultural norms surrounding physical activity, health, and travel (for an overview of cultural factors, public policies, and current urban planning practices that affect physical activity levels in China, see Day et al., 2013).

The design of Chinese cities to promote physical activity is a timely issue. China is expanding its cities at a rapid rate to accommodate enormous growth in its urban population—including an additional 200 million residents between 1990 and 2000 (The State of China's Cities, 2010). Accommodating this population could require an estimated 170 new mass-transit systems, 5 billion square meters of road, and 40 billion square meters of new floor space. Though the rate of development may slow in China's current economic situation, it is important to understand the links between the built environment and physical activity to help inform these extensive city building efforts.

This paper reviews existing research on the relationship between the built environment and physical activity in China. It identifies what is known so far, suggests key questions for future research, and highlights some potential differences in the relationship between the built environment and physical activity in China compared to research findings from developed countries.

2. Methods

This paper reviews 42 published empirical studies on physical activity and the built environment in China. The paper is modeled closely on a paper by Saelens and Handy (2008). Saelens and Handy (2008) are widely cited—701 times as of July 6, 2015, according to Google Scholar. Saelens and Handy (2008) reviewed 13 published literature reviews and 29 empirical research reports on the association between walking and the built environment. Their paper offers a systemic framework for analysis of literature that is replicable and that, importantly, allows for comparison with the present review. Saelens and Handy's (2008) review provides a guide for the organization of this paper and for the methods of analysis. Note that Saelens and Handy (2008) review studies from developed countries only (reflecting the available literature at that time). They focus exclusively on walking. The present paper, in contrast, reviews studies from China only and includes research on various types of physical activity, including walking and others.

For the present paper, a systematic search was conducted to identify studies published on the association between the built environment and physical activity in China. Search terms used in Web of Science (science and social science) included "physical activity," "walk," "bicycle," "bicycling," "travel," "transportation," "exercise," "recreation," "mode share" AND "environment," "park," "sidewalk," "trail," "mixed use," "urban," "suburban," "urban design," "walkability," "walkable," "bike-friendly," AND "China." Additional search terms included "active living," "active design," "walkability" AND "China." Search terms used for this analysis were those identified by Saelens and Handy (2008), plus additional terms to include non-walking physical activity and to narrow the focus to China. A few search terms used by Saelens and Handy (2008), including environment, design, and neighborhood, were not included because these terms were overly broad for this analysis. Bibliographic lists prepared by the Robert Wood Johnson Active Living Research program from 2002 through 2011 were also searched, as was the Active Living Research program's list of research studies from outside of the USA. The reference lists of several published literature reviews on the built environment and physical activity were reviewed to identify studies on China. Finally, the reference lists for all studies that were included in this paper were reviewed to identify possible studies for inclusion.

Each study that as included in this paper met the following criteria: (1) published as a full paper (not only an abstract); (2) included a primary report of methods, analysis and findings; (3) published in a peer-reviewed journal; (4) included an examination of the association between the objective and/or perceived built environment and physical activity; (5) included research that was conducted (all or in part) in China; (6) published before or during 2014; and (7) written in English. Because of the focus of this paper on implications for planning and design of the built environment to support physical activity, studies that examined only the social, cultural or economic environment, were not included (as in Saelens and Handy, 2008). The built environment was defined broadly, and included concepts such as urban versus rural distinction, natural environment features, and also population density, which impacts transportation planning.

Studies were reviewed using a preliminary coding scheme based on Saelens and Handy (2008). The coding scheme specified factors such as year of publication, built environment data sources, built environment factors examined, and geographic unit of analysis. Twenty studies were reviewed using the preliminary coding scheme. Based on the review of the first 20 studies, the coding scheme was revised to include additional factors, such as disciplinary orientation of authors and additional types of physical activity (for work as well as for recreation and transportation). All studies were reviewed again using the revised coding scheme.

Review procedures included the following. Each study was characterized in terms of the country in which the data were collected, sample, built environment factors, geographic unit of analysis, type of physical activity, covariates, and major results. Studies were also coded in terms of methods used to collect data (e.g., survey, interview, observation) and on whether environmental data were objective or perceived. (For perceived environmental factors, data on the environment was provided by respondents themselves through self-report.) Studies were further characterized in terms of their geographic unit of analysis. This information was often vague. (The same was true in Saelens and Handy (2008).) Studies were further coded in terms of the types of environmental factors examined, and the environmental scale of the study (micro, meso or macro). As in Saelens and Handy (2008), micro-environments referred to the environments immediately around where an individual lives (or works or goes to school, for studies of workplaces or schools). Individuals who live on the same street could potentially vary in their micro-environments. Meso environments included the small scale environments in which an individual lives, such as a neighborhood or census block group. Macro-environments were the larger scale environments in which an individual lives, such as the city or county. All individuals within that scale are considered to have the same environment.

The review also identified the type(s) of physical activity measured (recreation, transportation, work, and/or general); and whether results were expected, unexpected, and null. Expectedness was based on prior empirical research and conceptual models on the relationship between the built environment and physical activity. "More" of the following built environment factors were expected to be associated with more physical activity: density; proximity to nonresidential land uses (includes mixed land uses, transit access); street connectivity; parks and open/green space (quality and availability); non-park physical activity facilities; pedestrian infrastructure (presence and condition); bicycle infrastructure (presence and condition); traffic safety; aesthetics (including cleanliness). "Less" of the following built environment factors were expected to be associated with more physical activity: distance to specific non-residential land uses; crime; traffic volume and noise; high