



# Public health in linkage to land use: Theoretical framework, empirical evidence, and critical implications for reconnecting health promotion to land use policy



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## ABSTRACT

The increasing health burdens pose great challenge for planners and policy makers to create a more livable city. Recent literature has linked land use to a wide range of illness and death causes in developed nations. It therefore requires evidence-driven and replicable frameworks to inform land use decisions that integrate with health promotion. This paper proposes a theoretical framework for the mechanistic links between neighborhood land use and public health; and then quantifies their associations at district level, using the case of Shenzhen in developing China. Data for 15 health indicators in 2010 are collected at district level; and a set of standardized land use variables (individual land use type, general land use mix, and physical street conditions) are proposed to comprehensively reflect the neighborhood land use characteristics. Spatial regression is employed to analyze the relationships between health outcomes and land use variables. Results show that the land use exploratory variables vary with health indicators, but several key land use determinants are identified: green land abundance, green land morphology, institutional land proximity, industrial land proximity, blue land abundance, street walkability and street connectivity. Structural equation modeling is further applied to examine the possible mediators and it demonstrates that the casual pathways between land use and public health are quite complex. The developed set of standardized land use variables can serve as practical tools to facilitate land use decisions with health considerations. In practice, several complexities at governance levels challenge the efforts to reconnect land use policies and public health promotion. We put forward three useful solutions to enhancing health connection with land use policy across different international settings. This study captures the nuanced health disparities varied with districts and indicators, and therefore produces some more generalized knowledge that ultimately helps develop land use policies aimed at promoting public health at home and abroad.

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## 1. Introduction

### 1.1. Background

Present-day urban areas are home to over 50% of the world's population, and the number is predicted to reach approximately 70% by 2050 (United Nations, 2012). They are not only the main battlefields of the ongoing urbanization and densification, but also the

hotspots for global environmental changes (Hassan and Lee, 2015). While the urban environments provide socioeconomic infrastructures to support quality of life, the inhabitants can face great burden of adverse health outcomes, considering the integrated exposures to air pollution, noise, extreme climate events, unhealthy food environment, and socioeconomic pressures (Vaz et al., 2015; Wey and Wei, 2015). Approximately 24% of the global health burden, estimated by the World Health Organization, is due to the modifiable urban environments (Romano and Knechtges, 2014). Besides, the prevalent non-communicable diseases (NCDs) in urban settings have become the biggest global health threat, accounting for 63% of the total deaths worldwide (Hanson and Gluckman, 2015).

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Planners and policy makers thus long for solutions to creating a more livable city. Enhancing urban liveability and identifying the causal pathways assuming how urban environments impact health are recognized as major challenges within both research agendas and the international policies (Major Cities Unit, 2011; World Health Organization (2010)).

Land use planning, public health governance and environmental regulation share common origins in attempt to address the challenges for dwellers' health burden (e.g., environmental pollution, infectious diseases, and urban crowding) (Ashe et al., 2003; Barton, 2009; Chapman, 2011; Harris et al., 2010). However, these disciplines have been divergent and currently operate in separate fields (Harris et al., 2016; Koohsari et al., 2013; Wernham, 2011). Yet recent literature has linked land use to a wide range of illness and death causes in developed nations, including the asthma (Son et al., 2015), high blood pressure (Langerudi et al., 2015), cancer (Lopez-Cima et al., 2011), cardiovascular disease (Chum and O'Campo, 2015; Réquia Júnior et al., 2015), injury (Factor et al., 2013), mental disease (Barton and Pretty, 2010), obesity (Brown et al., 2009), and general health (Gascon et al., 2016; Richardson and Mitchell, 2010). Scholars have good theoretical reasons to believe the empirical linkages, since land use can shape the inhabitants' lifestyles and subsequently impacts their health (Brown et al., 2009; Heinrich et al., 2010; Wu et al., 2016). The potential pathways for public health in linkage to land use are summarized in the conceptual framework of Fig. 1:

- Some land use types act as protective factors for environmental pollution (e.g., groves, forest, lawns and natural water body) and physical inactivity (e.g., institutional land, open spaces, and green spaces), which in turn associate with several NCDs such as cardiovascular diseases, obesity, hypertension, and diabetes (Durstine et al., 2013; Mackenbach et al., 2014; Jones et al., 2007).
- High land mix indicates more accessibility to services and facilities for daily basic needs, which can enhance the social interactions and independent living (Hajna et al., 2014; Nelson et al., 2006; Wu et al., 2016). Such activities can produce potential psychosocial effects on quality of life, NCDs development, and mental well-being (Brennan-Olsen et al., 2015; Weng et al., 2016).
- Good street transportation conditions (e.g., connectivity, walkability, and safety) can better active commuting and social contacts, along with reductions in depression and stress (Badland

et al., 2015; Factor et al., 2013). These psychological and behavioral influences make neighborhood land use to be a strong predictor for health outcomes (Barton and Pretty, 2010).

This body of research gives rise to an alarming challenge for land use policy: land use lies beyond the jurisdiction of health sectors and policy-making is frequently without the participation of health professionals. This challenge has motivated the increasing call for “health in all policies” using cross-sector approaches (World Health Organization and Government of South Australia, 2010). As such, land use policies should set forth goals in close fit with public health practices, and implement plans that are instrumental in shaping land use patterns towards health improvement. Ultimately, practical tools that facilitate the integration of health into policy-making procedures are needed for government agencies to revise land use plans, make decisions, and develop regulations. In order to make progress towards achieving these perspectives, it first requires evidence-driven and replicable frameworks to inform land use policy that integrates with health promotion. This article seeks to advance this specific field by providing guidance for: (1) grasping the associations between different aspects of land use characteristics and various health outcomes; (2) developing a standardized set of land use variables to assess the linkage between land use characteristics and public health; (3) identifying the key land use variables that act as generalized determinants of public health; (4) understanding the casual pathways hypothesizing how neighborhood land use impact public health; and (5) perhaps more importantly, framing health for land use policies.

## 1.2. Literature review

Pioneering scholars are motivated by the hypothesis that the integrated environment exposures (e.g., air pollution, noise, thermal pollution, and other factors) can be represented by the land use around residence (Durstine et al., 2013; Mackenbach et al., 2014; Jones et al., 2007). They start to examine the statistical correlations between public health outcomes and a variety of land use types in different urban areas (Brown et al., 2009; Chum and O'Campo, 2015; Factor et al., 2013). The statistical correlations can be used as tools to understand the associations, although they may not necessarily suggest causality (Langerudi et al., 2015). For example, green spaces (e.g., groves, forest and lawns) have been suggested to have

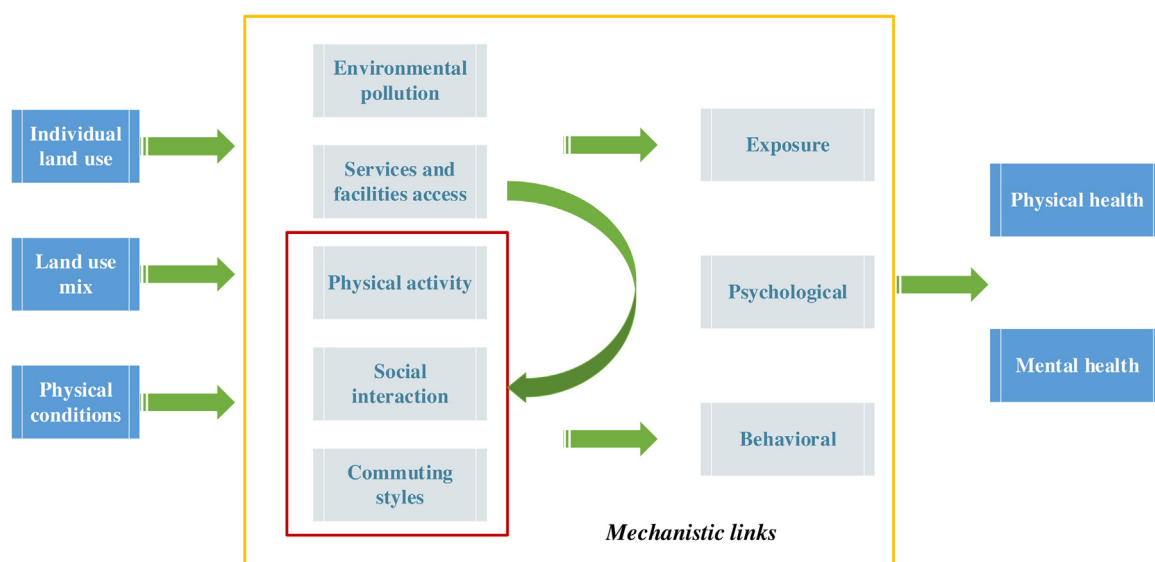


Fig. 1. Conceptual framework for the potential mechanistic links between neighborhood land use and public health.

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