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Designing healthy communities: Testing the walkability model

Adriana A. Zuniga-Teran*, Barron J. Orr,
Randy H. Gimblett, Nader V. Chalfoun, Stuart E. Marsh,
David P. Guertin, Scott B. Going

Udall Center for Studies in Public Policy, University of Arizona, Tucson, AZ 85719, USA

Abstract
Research from multiple domains has provided insights into how neighborhood design can be improved to have a more favorable effect on physical activity, a concept known as walkability. The relevant research findings/hypotheses have been integrated into a Walkability Framework, which organizes the design elements into nine walkability categories. The purpose of this study was to test whether this conceptual framework can be used as a model to measure the interactions between the built environment and physical activity. We explored correlations between the walkability categories and physical activity reported through a survey of residents of Tucson, Arizona ($n=486$). The results include significant correlations between the walkability categories and physical activity as well as between the walkability categories and the two motivations for walking (recreation and transportation). To our knowledge, this is the first study that reports links between walkability and walking for recreation. Additionally, the use of the Walkability Framework allowed us to identify the walkability categories most strongly correlated with the two motivations for walking. The results of this study support the use of the Walkability Framework as a model to measure the built environment in relation to its ability to promote physical activity.

1. Introduction

The increasing lack of physical activity among all populations is considered a global public health problem ("WHO| Physical Inactivity", n.d.). Public health efforts to improve health typically promote moderate types of physical

*Corresponding author.
  E-mail addresses: aazuniga@email.arizona.edu,
aazunigat@gmail.com (A.A. Zuniga-Teran).
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activity, such as walking and biking, because these are easier for inactive populations to begin and maintain and these are also easier to incorporate into daily routines (Frank et al., 2003). The built environment has been identified as an essential factor for integrating physical activity into one's daily life (Cerin et al., 2013; Frank et al., 2003; Frumkin et al., 2011; Sallis et al., 2011). International organizations such as the World Health Organization (WHO) have called for changes to be made in the built environment to improve human health through walking, including changes in urban design, transportation and recreational facilities (Adams et al., 2013). For such changes to be effective, it is critical to identify the design elements of the built environment that influence physical activity. In other words, what elements of the built environment encourage people to walk?

There are different motivations for walking that require different elements from the built environment. Behavioral scientists have identified two primary motivations for walking: recreation and transportation (Giles-Corti et al., 2005; Saelens and Handy, 2008). Walking for recreation refers to walking for exercise or simple recreation, whereas walking for transportation refers to walking to reach a destination (Saelens and Handy, 2008). Research has identified distinctions in the types of walking and how they are influenced by the built environment: walking for transportation has been shown to be related to the design of the neighborhood, whereas recreational walking has not been shown to be affected by neighborhood design (Rodríguez et al., 2006; Saelens et al., 2003; Toit et al., 2007).

To assess the design elements of the built environment that influence physical activity, it is necessary to both capture the state-of-the-art research on walkability and organize findings in a way that can be readily used by those directly influencing the design of the built environment (e.g., architects, builders, developers, and planners). The Walkability Framework developed by Zuniga-Teran (2015) and later applied by Zuniga-Teran et al. (2016) serves both of these purposes (Fig. 1). The framework synthesizes hypotheses from several research domains in which the relationship between the built environment and walkability is explored. These domains include physical activity, land planning and transportation, thermal comfort, health, and greenspace. The framework also addresses walkability from the perspective of architecture and urban design through the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) design guidelines (USGBC, 2016). Finally, the framework groups the neighborhood design elements that have been identified theoretically as essential factors for physical activity into nine walkability categories: connectivity, density, land use, traffic safety, surveillance, experience, parking, greenspace, and community.

The *connectivity* category measures how well a street network provides multiple, direct, and short routes to reach different destinations. It is desirable to have a high level of connectivity to facilitate walking; and this is thought to be achieved by having small blocks (short distance between intersections), a grid street network (as opposed to cul-de-sacs or dead-end streets), and open to the public (as opposed to fenced or gated communities). The *density* category refers to residential density and captures design elements that increase the number of people in the streets, which is thought to be related to walking. These refer to the prevalent types of dwelling units in the neighborhood (e.g., single-family housing, townhomes, apartment buildings). The *land use* category measures the diversity of land uses (e.g., residential, commercial) within walking distance (less than 1/2 mile or 800 m, or a 10-min walk) from the respondent's residence. Locating a variety of small businesses (e.g., shops, restaurants, offices) close to homes facilitates and encourages walking. The *traffic safety* category highlights the infrastructure needed to facilitate pedestrian and bicycle safety in the presence of traffic. Slowing traffic and giving pedestrians and bicyclists safe places to travel by providing space/infrastructure (e.g., sidewalks, bike lanes) encourage walking. The *surveillance* category measures how well those traveling on the street can be seen from the surrounding homes and businesses. It is hypothesized that buildings designed in such a way that people inside the buildings can observe the street (e.g., via balconies, front porches, short building setbacks, and back alleys serving garages) encourage people walking by enhancing the perception of safety from crime. Streetscapes should also encourage activity on the sidewalks (e.g., outdoor cafes, clear windows for shops) and should include other design elements that reduce crime (e.g., lighting). The *experience* category measures whether the built environment provides a pleasant experience while walking. In this category, we include the streetscape proportions, aesthetics (graffiti, trash, buildings, sights), wayfinding considerations (signage, landmarks), thermal comfort (trees, shade), slope (hilly streets), and presence of dogs/wildlife. The *parking* category measures the availability of parking, where the less parking provided is thought to be more walkable. Not only is walking through a parking lot undesirable, but if there is no parking available, people may choose an alternative mode of transportation besides cars that may involve physical activity. If parking is necessary, then locating parking behind buildings and away from the street is thought to create an area more interesting and walkable. The *greenspace* category measures the availability of spaces dominated by vegetation; the size, proximity, and ease of access of the greenspaces are all considered in this category.
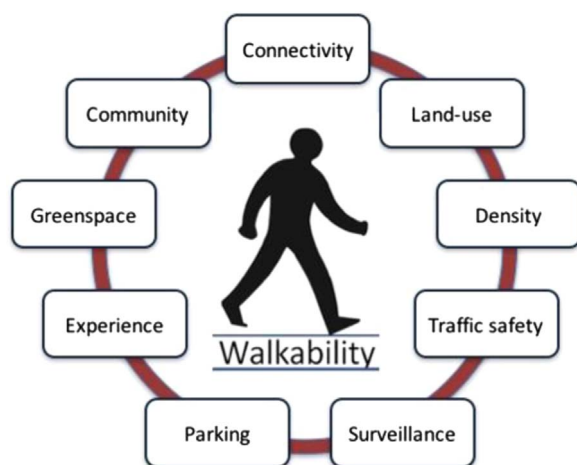

Fig. 1 *The Walkability Framework* shows the interrelation between the nine neighborhood design categories that when combined result in walkability.