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Contextualizing Walkability:

Do Relationships Between Built Environments and Walking Vary by Socioeconomic Context?

Arlie Adkins, **Carrie Makarewicz**, **Michele Scanze**, **Maia Ingram**, **Gretchen Luhr**

Arlie Adkins is an assistant professor of planning in the School of Landscape Architecture and Planning at the University of Arizona. Carrie Makarewicz is an assistant professor in the College of Architecture and Planning at the University of Colorado, Denver. Michele Scanze is a recent graduate of the planning master's program at the University of Arizona. Maia Ingram is the codirector of the Arizona Prevention Research Center at the University of Arizona. Gretchen Luhr is a research associate at the Institute on Aging at Portland State University.

Abstract

Problem, research strategy, and findings: Supportive built environments for walking are linked to higher rates of walking and physical activity, but little is known about this relationship for socioeconomically disadvantaged (e.g., low-income and racial/ethnic minority) populations. We review 17 articles and find that most show that the built environment has weaker effects on walking and physical activity for disadvantaged than advantaged groups. Those who lived in supportive built environments walked more and were more physically active than those who did not, but the effect was about twice as large for advantaged groups. We see this difference because disadvantaged groups walked more in unsupportive built environments and less in supportive built environments, though the latter appears more influential.

Takeaway for practice: Defining walkability entirely in built environment terms may fail to account for important social and individual/household characteristics and other non–built environment factors that challenge disadvantaged groups, including fear of crime and lack of social support. Planners must be sensitive to these findings and to community concerns about gentrification and displacement in the face of planned built environment improvements that may benefit more advantaged populations. We recommend five planning responses: Recognize that the effects of the built environment may vary by socioeconomics; use holistic approaches to improve walkability; expand walkability definitions to address a range of social and physical barriers; partner across agencies, disciplines, and professions; and evaluate interventions in different socioeconomic environments.

Keywords

walking; transportation equit; walkability; socioeconomic context

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In the past several decades hundreds of studies in the fields of urban planning and public health have identified key characteristics of the built environment associated with active

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arlieadkins@email.arizona.edu.

transportation; physical activity; and related health outcomes, such as lower rates of obesity, cardiovascular disease, diabetes, and stroke (Hardman & Stensel, 2009). The evidence has been fairly consistent: Supportive built environments for walking, bicycling, and transit use are predictive of a larger share of trips made by active travel modes and higher rates of walking or physical activity (Durand, Andalib, Dunton, Wolch, & Pentz, 2011; Ewing & Cervero, 2001, 2010; C. Lee & Moudon, 2006; Saelens, Sallis, & Frank, 2003; Sugiyama, Neuhaus, Cole, Giles-Corti, & Owen, 2012; Talen & Koschinsky, 2013). Mayne, Auchincloss, and Michael's (2015) recent review of natural experiment studies (i.e., before and after) of built environment interventions highlights the effectiveness of infrastructure improvements for increasing walking and physical activity, though with a caveat that weaker study designs may overstate the impacts of the built environment.

Buoyed by this evidence, planners, public health professionals, and policy-makers have identified walkable built environments that increase rates of walking as a key strategy for improving population health (American Planning Association, 2015; Centers for Disease Control and Prevention, 2017; U.S. Department of Health and Human Services, 2015).

Missing from much of this literature, however, is an understanding of how relationships between walkable or supportive built environments and walking and physical activity might vary by socioeconomic context (Day, 2006). In the past decade, as planners have paid increasing attention to socioeconomics-based disparities and issues of equity in transport-related access, opportunity, health, and safety, researchers have begun filling this gap in knowledge with empirical studies of these differences.

In this review we aim to provide additional nuance to the decades-long conversation about transportation and the built environment by identifying and synthesizing the small but growing body of research on differences in the effect of the built environment on walking and physical activity in different socioeconomic contexts. We review studies of transport walking, leisure walking, and physical activity because although physical activity and leisure walking may be less dependent on built environment characteristics, each of these behaviors has been linked to characteristics of the built environment, and researchers and practitioners in both public health and planning commonly tout their links to health benefits (American Planning Association, 2015; Centers for Disease Control and Prevention, 2017). We therefore use a definition of supportive built environment for walking that could address needs of transport and leisure walking as well as physical activity more broadly.

We begin by laying out a theoretical framework to explain why differences in built environment effects on walking and physical activity might exist and what the implications of such differences are for research and practice. Next, we summarize the various ways in which walking and walkability intersect with social equity in disadvantaged communities. These include health and safety disparities, inequities in built environments and infrastructure, marginalization in planning processes, and concerns regarding displacement and gentrification as the demand for walkable urban neighborhoods increases. We then provide a summary of how the planning literature on the built environment and travel behavior has—and, more often, has not—examined socioeconomic differences in observed relationships. We then describe our method for identifying and synthesizing the small subset of the broader literature that has explicitly looked at differences in built environment effects on walking between advantaged groups (e.g., higher income, White non-Hispanic, and highly educated) and disadvantaged groups (e.g., low income, racial/ethnic minorities, low educational attainment).

Of the 17 studies we identify and include in our review, 13 show stronger built environment effects on walking and physical activity for advantaged groups than for disadvantaged groups. Two find no difference, and two show a bigger built environment effect for disadvantaged groups. Five of the 17 studies provide enough information to compare the magnitude of the difference across studies. This subset of studies suggests that the effect of the built environment on walking and physical activity may, in some instances, be as much as two times stronger for advantaged groups than for disadvantaged groups. These studies also provide evidence that observed differences in built environment effects are the result of both more walking by disadvantaged groups than advantaged groups in unsupportive built environments and less walking by disadvantaged groups than advantaged groups in supportive built environments, though the latter relationship appears to be stronger.

Identifying and quantifying differences between socioeconomic groups in the relative built environment effect on walking and physical activity contributes to efforts by planning and public health researchers and practitioners to address transportation-related health and safety disparities. We position our findings within larger discussions about transportation equity and active transportation (R. J. Lee, Sener, & Jones, 2017), mismatches between planning goals and community goals (Aytur, Rodriguez, Evenson, Catellier, & Rosamond, 2008; Talen & Koschinsky, 2013), and neighborhood change and gentrification (Chapple & Zuk, 2016) by briefly reviewing the relevant literature in these areas and connecting the findings to our recommendations for research and practice.

Why Would Built Environment Effects on Walking and Physical Activity Vary by Socioeconomics? A Conceptual Framework

Social ecological frameworks have been widely adopted in public health to highlight the complexity and interconnectedness of physical environments, social environments, and public policies as determinants of behaviors ranging from physical activity to nutrition to smoking cessation (Sallis, Owen, & Fisher, 2008). Social ecological frameworks have relevance for planners because they help to position their primary areas of influence—the physical environment—within the broader context of people's day-to-day lives. It is critical to understand how planning, design, and engineering interventions, for example, might interact with and lead to different outcomes based on the socioeconomics of an individual or neighborhood.

Planning for walkability remains largely a built environment endeavor, despite the adoption of social ecological frameworks by some planning scholars (Alfonzo, 2005; Miles & Jacobs, 2008; Rodríguez, Khattak, & Evenson, 2006; Sallis et al., 2006; Stewart, Vernez Moudon, & Claybrooke, 2012) and new research on the importance of social factors related to walking (Belon, Nieuwendyk, Vallianatos, & Nykiforuk, 2016; Bracy et al., 2014). A recent survey of pedestrian master plans and the planners responsible for overseeing them in 50 U.S. cities shows that although 30% of the plans reviewed included provisions for safety and security, they mostly only addressed safety as preventing automobile collisions, despite evidence that fear of crime prevents walking (Stangl, 2011). Stangl (2011) also finds that 30% of plans noted demographics and socioeconomic characteristics related to walking, but none of the 57 planners surveyed listed this as one of the most important considerations in planning for walkability. Connectivity of the pedestrian network, basic pedestrian infrastructure, pedestrian-oriented land uses, and connections to mass transit were the most important items noted by planners and included in their plans.

In Figure 1, we lay out a theoretical framework showing the factors that, according to the relevant literature, contribute to weaker built environment effects on walking and physical activity for disadvantaged groups. We do not, for the sake of simplicity, discuss these factors with regard to advantaged groups or include those relationships in the model. Similarly, we only include relationships in the model that would result in a weaker built environment effect for disadvantaged groups. For example, although social supports likely occur in both supportive and unsupportive built environments, only in unsupportive built environments would their positive influence lead to an unexpected walking or physical activity outcome related to the built environment.

In unsupportive built environments, as illustrated in the top left of Figure 1, disadvantaged groups may walk more or be more physically active than expected based on the built environment for two reasons. First, there are two key ways in which the choices of disadvantaged groups are constrained: Lower rates of car ownership (Blumenberg & Pierce, 2012; Serulle & Cirillo, 2016) limit transportation choices to those modes that require walking and physical activity, including transit (Lachapelle, Frank, Sallis, Saelens, & Conway, 2016); and there is limited ability to relocate into neighborhoods with built environments supportive of walking, particularly in urban areas where demand for housing in walkable neighborhoods is high and the market demands a price premium (Cortright, 2009; Leinberger & Alfonzo, 2012; Manaugh & El-Geneidy, 2011; Owen et al., 2007; Tremoulet, Dann, & Adkins, 2016). Second, there may be supportive social environments in some disadvantaged communities, including social interaction, social cohesion, and social capital, that compensate for some deficiencies in the built environment, such as poor sidewalk infrastructure (Clark & Scott, 2013; Cleland et al., 2010; McDonald, 2007; McDonald, Deakin, & Aalborg, 2010; Miles & Panton, 2006; Oka, 2011). The importance of social environment supports is, of course, not limited to socioeconomically disadvantaged groups, but there is some evidence that it may be particularly helpful in that context (Cleland et al., 2010; Miles & Panton, 2006).

In supportive built environments, as illustrated in the top middle of Figure 1, economically disadvantaged groups may not walk as much as advantaged groups because of barriers in the social environment or constraints due to individual or household characteristics. Perceptions of personal safety and both perceived and objectively measured crime rates have been clearly linked to participation in neighborhood-based walking and physical activity, particularly for disadvantaged groups (Loukaitou-Sideris, 2006; Lovasi, Hutson, Guerra, & Neckerman, 2009; Timperio, Veitch, & Carver, 2015). Other potential social environment constraints are lack of social cohesion (Echeverría, Diez-Roux, Shea, Borrell, & Jackson, 2008; Fisher, Li, Michael, & Cleveland, 2004), complex relationships with police (Menjívar & Bejarano, 2004), and the presence of loose and/or aggressive dogs (King et al., 2006).

Individual- and household-level factors may also attenuate the relationship between neighborhood walkability and physical activity. Disadvantaged groups, for example, may be more likely to have physically demanding jobs that help them meet recommended levels of physical activity and make them less likely or able to walk for transport or leisure. Other individual factors, such as time constraints, physical ability, having children, age, and mental health, can all influence participation in physical activity at a household or intrapersonal level (Alfonzo, 2005; Sallis et al., 2006) and are likely more burdensome for vulnerable or disadvantaged populations.

Another factor that likely contributes to a weaker effect of the built environment on walking and physical activity for disadvantaged groups is that standard indicators of walkable built environments may simply be wrong or biased in how they treat disadvantaged groups (Day, 2006; Jackson, 2003; Koschinsky, Talen, Alfonzo, & Lee, 2016; Manaugh & El-Geneidy, 2011). Indicators of walkability that have been developed and tested largely in the context of relatively advantaged communities may incorrectly measure, or miss entirely, characteristics of the built and social environments that support or discourage walking in a specific socioeconomic context. Such error in measurement would contribute directly to a weaker effect of the built environment on walking and physical activity for disadvantaged groups because these indicators would not be calibrated to the specific context. In this review, unfortunately, we are not able to determine the degree to which potential bias in walking behavior models contributes to the difference in the effect of the built environment on walking and physical activity. We include this research bias in our theoretical model both as a direct contributor to a weaker built environment effect on walking and physical activity and as part of a feedback loop wherein the weaker effects of the built environment on walking and physical activity themselves could lead to mistaken conclusions by researchers.

Inequities Related to Walking and Walkability

Disadvantaged populations face substantial disparities in walking, walkability, safety, and health as well as inequities in infrastructure and built environment conditions, marginalization in planning processes, and the threat of displacement as the demand for walkable urban neighborhoods increases. Low-income and racial/ethnic minorities are at higher risk for obesity, cardiovascular disease, and other chronic illnesses linked to physical inactivity (Hardman & Stensel, 2009). The benefits of walking, although widely touted to these groups, can come at a higher cost for disadvantaged and vulnerable populations, with low-income and racial/ethnic minorities facing considerably higher pedestrian injury and fatality rates than more advantaged groups. Black and Hispanic/Latino men, for example, have pedestrian fatality rates approximately twice that of White men (Centers for Disease Control and Prevention, 2013). Low-income, Black, and Hispanic/Latino households in urban areas are also disproportionately exposed to dangerous industrial and tailpipe emissions linked to asthma and other respiratory diseases (Kravitz-Wirtz, Crowder, Hajat, & Sass, 2016). A recent study in Vancouver (BC, Canada) makes connections between walkability and emissions exposure, finding that areas of the city categorized as low income and highly walkable have some of the highest rates of nitric oxide exposure (Marshall, Brauer, & Frank, 2015). And there is evidence that pedestrians along roadways may be particularly vulnerable to such disparities in emissions exposure due to proximity to vehicles and emissions uptake through heavier breathing (Bigazzi & Figliozzi, 2014; Moore et al., 2011).

Some of the safety- and health-related disparities mentioned above are linked to inequities in infrastructure and built environment conditions, including fewer sidewalks. Across all counties in the United States, those with higher levels of poverty and lower rates of education were less likely to implement sidewalk and bike projects with federal funding from 1994 to 2002 (Cradock et al., 2009). Several city case studies document lower sidewalk quality, continuity, and availability in low-income neighborhoods (Kravetz & Noland, 2012; Leinberger & Alfonzo, 2012; Lowe, 2016). Some of these inequities may be linked to historic processes of disinvestment (Lubitow & Miller, 2013), exclusion from or marginalization in the planning processes (Umemoto, 2001), or some combination of these factors resulting in misalignment of the goals of the community and planners (Miller & Lubitow, 2014). Gentrification is another key area of concern. Characteristics of walkable built environments are good enough indicators of gentrification risk that in some cities they are used as inputs in gentrification early warning systems (Chapple & Zuk, 2016).

How Has Built Environment–Travel Behavior Research Handled Socioeconomic Differences?

Since the late 1980s, planning and transportation researchers have produced a significant body of literature establishing the built environment’s influence on travel mode decisions, even when controlling for socioeconomics, attitudes, motivations, and preferences (Cao, Mokhtarian, & Handy, 2009; Ewing & Cervero, 2001; Greenwald & Boarnet, 2001; Kitamura, Mokhtarian, & Laidet, 1997). It has been common practice to include socioeconomic characteristics as control variables, but only a handful of studies that control for socioeconomics attempt to explain the observed difference by socioeconomics. Even fewer authors have made socioeconomic effects the focus of their inquiry (Day, 2006; Ewing & Cervero, 2001; Forsyth, Oakes, Lee, & Schmitz, 2009; Hearst et al., 2013; Kerr, Frank, Sallis, & Chapman, 2007; Koskela & Pain, 2000; Loutzenheiser, 1997; Pucher & Renne, 2003). C. Lee and Moudon, by 2004, conclude that reporting of socioeconomic influences on dependent variables related to travel behavior tended to be “brief and vague” (p. 153).

In the late 1980s, as planners in general returned their attention to physical planning (Beauregard, 1989; Friedmann, 2000; Jacobs & Appleyard, 1987; Pivo, Ellis, Leaf, & Magutu, 1990), interest in smart growth, environmental concerns, and the rise of new urbanism prompted a new wave of research on travel and the built environment, with some taking an interest in active travel (Handy, 1992, 1996a; Steiner, 1996). Handy’s 1992 study on nonwork travel in neotraditional developments and several subsequent studies conclude that the effect of the built environment was directly related to individuals’ motivation to walk and a lack of barriers and limitations to walking or physical activity (Handy, 1996a, 1996b, 2005a).

Studies conducted in the 1990s rarely address differences in walking by measures of socioeconomic disadvantage, except for some that focus on individual mobility limitations, such as lack of car ownership. There appear to be two reasons for the lack of focus on socioeconomics. First, researchers were primarily interested in testing the claims of new urbanists and others that neotraditional designs could reduce vehicle miles traveled for nonwork trips because their aim was often to address environmental issues and congestion due to sprawl and increasing auto use. Several authors have observed that much of the early active travel research focused on comparing suburban neighborhoods with or without traditional neighborhood designs (Ewing & Cervero, 2010; Forsyth, Hearst, Oakes, & Schmitz, 2008; Handy, 2005a, 2005b). Bagley and Mokhtarian (2002) and Steiner (1996) note that because these areas tended to be White and middle or upper class, identifying differences by income and race is not possible.

Second, the design of much of the research agenda was a response to skepticism from travel behaviorists about whether observed associations between urban form and travel behavior were causal or simply artifacts of socioeconomics and self-selection. It is common in the built environment travel behavior literature of the time, as a result, for researchers to control for socioeconomic factors to highlight the independent effects of the built environment (e.g., Boarnet & Sarmiento, 1998; Cervero & Landis, 1995). The strategy of preemptively controlling for socioeconomics by selecting study areas with similar socioeconomic profiles further limited opportunity for comparisons by socioeconomic context (e.g., Handy, 1996b; Kitamura et al., 1997; Lund, 2003; Moudon, Hess, Snyder, & Stanilov, 1997).

Researchers in the late 1990s and early 2000s also focused on developing better built environment measures to address the skepticism about the effects of the built environment, arguing that lack of appropriate specification of the environment can explain lower than expected associations. Thus, the 3 Ds—design, diversity, and density—coined by Cervero and Kockelman (1997) were not only readily adopted by researchers but subsequently augmented with a fourth D that controlled for demographics and eventually a fifth and a sixth, destination and distance (Ewing & Cervero, 2010; Ewing, Hajrasouliha, Neckerman, Purciel-Hill, & Greene, 2016). These efforts to improve and systematize objective built environment measures were aided by advances in GIS technology (Aultman-Hall, Roorda, & Baetz, 1997) and the development of built environment audit instruments (Moudon & Lee, 2003).

By 2001, enough research had been published in this area to allow Ewing and Cervero (2001) to conduct a metareview of 50 articles summarizing how and when travel is influenced by the built environment or individual characteristics. They conclude that “trip frequencies appear to be primarily a function of socioeconomic characteristics…and secondarily a function of the built environment” and that “mode choices depend on both the built environment and socioeconomics (although they probably depend more on the latter)” (p. 87).

Planning scholars have recognized the important role of socioeconomics, but not in sufficient detail to explain how the social environment may mediate the built environment’s effect on travel behaviors. Two national studies for a committee of the Transportation

Research Board in 2005 acknowledge this issue. The National Research Council Committee on Physical Activity and Land Use (National Research Council Committee on Physical Activity and Land Use & Institute of Medicine, 2005) focuses on the mediating influences in lower socioeconomic neighborhoods, noting that "crime-ridden streets, littered sidewalks, and poorly maintained environments discourage outdoor physical activity other than necessary trips" (p. 222). But the committee did not recommend addressing how improvements in these negative influences would affect physical activities, citing insufficient evidence. Handy's (2005a) synthesis for the same committee argues that these mediating variables are part of the relationship between urban form and travel behavior, and thus studies should not control for them as exogenous influences.

A smaller stream of studies in the early 2000s explored our review's focus on the inconsistencies across socioeconomic contexts that affect the strength and predictability of the built environment effect. Day (2006) calls for more research to understand the social context effects on active travel, especially in Latino, African-American, and other communities with high health risks, few resources, and lower rates of walking. Through participatory research in suburban Los Angeles (CA), she identifies four improvements that can increase walking in low-income areas: 1) safety from traffic, 2) perceived safety from crime, 3) nearby jobs and other destinations for urban residents, and 4) the provision of parks and recreational facilities. A few studies note specific differences by income, race, and ethnicity in how people respond to specific built environment measures. Other studies using qualitative methods find that decisions to walk are more complex than the ability or desire to drive or the presence of sidewalks. Issues of class, race, and gender are associated with fear of or experience with crime, and a sense of belonging or exclusion also affects the decision to walk or use public spaces (Day, 1999, 2006; Pain, 2001). Moudon et al. (1997) observe a disproportionately high number of people of color walking in the Seattle (WA) area, including in unexpected areas, such as low-density urban and suburban contexts. The authors lacked individual-level data, so they assume that the walkers could not or did not want to drive. Car ownership or availability is closely linked to income, and several studies have identified it as a mediating factor in the relationship between the built environment and walking (Forsyth et al., 2009; Hearst et al., 2013; Joh, Nguyen, & Boarnet, 2012; Kerr et al., 2007; Lachapelle et al., 2016; Marquet & Miralles-Guasch, 2014).

Researchers have long noted the small effects of the built environment on travel behavior, particularly relative to the stronger influence of social and economic factors (Ewing & Cervero, 2010; Giuliano & Small, 1993; Stevens, 2017). Those defending the importance of the relationship between the built environment and travel behavior, most recently in response to Stevens's (2017) metaregression review of 37 studies in the Spring 2017 issue of this journal, argue that small elasticities can still have beneficial impacts (Ewing & Cervero, 2017; Handy, 2017; Nelson, 2017). Some also note that more advanced and nuanced research methods, such as structural equation modeling (which captures indirect effects), controlling for residential self-selection (which controls for bias toward selecting a home in a location to have alternative travel options), and more detailed data on household travel and built environment characteristics at a small scale, have led to greater precision and better results.

The topic of our review fits nicely within this recent *Journal of the American Planning Association* conversation because, as Handy (2017) points out with a phrase borrowed from public health, more studies are needed on “upstream” questions that explore “the relationships that come before the land use travel behavior relationship in the long chain of causal relationships involved” (p. 28). New technology and research methods, and asking the right questions—one of the aims of our review—will help the planning profession get more from its “messy,” but ultimately necessary, understanding of built environment–travel behavior relationships (p. 26). This echoes previous calls to apply a more comprehensive social ecological framework to studies of walkability, walking, and physical activity (Alfonzo, 2005; Aytur et al., 2008; R. J. Lee et al., 2017; Oka, 2011; Sallis et al., 2006).

Identifying Studies for Review

Our research team faced the task of identifying the small subset of the hundreds of empirical studies on the relationship between the built environment and walking and physical activity that explicitly compared the strength of this relationship in different socioeconomic contexts. We used Google Scholar, PubMed, and Transport Research International Documentation to identify published research meeting these criteria. We placed no restrictions on publication date, discipline, or the geographic location of the studies. Most relevant literature, as we expected, was published in public health, planning, design, or transportation-related journals. Table 1 shows the search terms we used to capture various combinations of socioeconomic context (e.g., low income), outcome (e.g., walking or physical activity), and built environment (e.g., walkable/supportive). We identified 155 articles that we then narrowed down to 66 after we reviewed the abstracts; the research team included both urban planning and public health faculty and graduate students. Then, through a thorough reading of these 66 articles, we identified 13 articles that empirically compared differences in built environment effects on walking and physical activity between disadvantaged and advantaged groups.

We supplemented this database search in two ways given the complexity and specificity of our search. We reviewed the bibliographies of several well-known review articles from planning and public health that looked at the relationship between the built environment and walking or physical activity (Ewing & Cervero, 2010; Handy, Boarnet, Ewing, & Killingsworth, 2002; C. Lee & Moudon, 2006; Saelens & Handy, 2008). We reviewed the reference lists of the 13 articles identified through our database search. We found four additional articles through these supplemental steps, resulting in a total of 17 articles that empirically compared advantaged and disadvantaged groups. Two additional articles used similar methods and showed a similar pattern of a stronger built environment effect for advantaged groups but looked at obesity as a dependent variable (Casagrande, Gittelsohn, Zonderman, Evans, & Gary-Webb, 2011; Lovasi, Neckerman, Quinn, Weiss, & Rundle, 2009). We do not include these two studies in our narrative synthesis because although there is an established relationship between obesity and built environment, the additional factors contributing to obesity make comparison with walking and physical activity problematic.

Synthesizing Across Studies

We conducted a narrative synthesis, as described by Popay et al. (2006), because we could not conduct a meta-analysis given the diversity of measures, statistical methods, and data available in the 17 studies. Five of the studies, however, provided enough data in a similar format that we could further examine quantitative differences in the relationship between walking and physical activity in areas with supportive and unsupportive built environments for both advantaged and disadvantaged groups. The similar structures of these five studies allowed us to evaluate the data in several ways. As shown in Figure 2, for both advantaged and disadvantaged groups we calculated the difference in walking between unsupportive and supportive built environments. In the example shown in Figure 2, Sallis et al. (2009) observes 43 more minutes of weekly transport walking by the advantaged group in supportive versus unsupportive built environments. To compare across studies using different units, we then calculated the built environment effect as 410% more walking by the advantaged group in supportive versus unsupportive built environments. For disadvantaged groups, in this example, the built environment effect on weekly transport walking is 20.6 min, or 130%. After we calculated the percentage of built environment effects for each relationship tested in the five-study subset, we calculated a ratio to examine the relative effect of the built environment on walking between advantaged and disadvantaged groups.

We also graphed these relationships, as seen at the right of Figure 2, to more clearly illustrate the built environment effect. This shows both the built environment effect (the slope) and the difference in walking or physical activity between advantaged and disadvantaged groups in supportive and unsupportive built environments.

An Overview of Studies That Address Differences in Built Environment Effects on Walking and Physical Activity

The 17 studies included in our systematic review have varied study locations; analytical approaches; and operationalizations and measurement of socioeconomic disadvantage, built environment, walking, and physical activity. Table 2 provides a detailed summary of each study, including the population studied, the indicator of disadvantage, and its analytical methodological characteristics. In this section, we describe the general characteristics of the studies reviewed and discuss how each article’s findings support, challenge, or otherwise inform our findings.

All but three of the 17 articles meeting our strict selection criteria are from public health or other health-related journals. Several articles published in public health journals, however, are authored or coauthored by planning scholars; one of the articles published in a transportation planning journal is coauthored by public health researchers. Seven of the studies are from the United States, four each from Canada and Europe, and one each from Australia and New Zealand. Study locations range from very urban places like New York City (NY) and Stockholm (Sweden) to more suburban locations like Atlanta (GA) to rural South Carolina. The earliest study publication date is 2004. About half of the reviewed study publication dates are 2010 or later; the most recent publication date is 2015. Most of the studies sample adults (i.e., those 18 years of age and older), but two look exclusively at older adults and one at youth. The sample sizes are typically large: Only four studies have a sample of fewer than 2,000 people, and two of those four have fewer than 1,000.

The studies use a variety of methods. The most effective approach for answering our key research question is to group built environments using a two-by-two matrix, as illustrated in Figure 2, showing walking or physical activity for supportive/advantaged, supportive/disadvantaged, unsupportive/advantaged, and unsupportive/disadvantaged. Another common approach is to use regression analysis to test whether some indicator of disadvantage moderated (i.e., weakened) the relationship between built environment and walking or physical activity. The disadvantage of these studies, for our purpose, is that they often do not contain the necessary descriptive statistics allowing us to explore the relationship beyond simply knowing whether indicators of disadvantage had an effect on the relationship between the built environment and walking and physical activity. The more advanced statistical models sometimes include multiple socioeconomic indicators or closely associated ones such as car ownership, which makes it more difficult to ascribe significance to any one indicator of disadvantage.

As shown in Table 2, the studies use an array of different indicators of disadvantage, which we have put into three categories: income, race/ethnicity, and educational attainment. Researchers handle the variables within these categories differently. Some look at neighborhood-level or census unit indicators of disadvantage, whereas others use individual or household indicators. Some use continuous measures, whereas others use thresholds and dichotomous variables to indicate disadvantage. Some researchers include race as a comparison between White non-Hispanics and people of color broadly; others compare individual racial and ethnic groups.

Indicators of walkability mostly focus on residential density, street connectivity (or intersection density), and land use mix. Other less common indicators are transit availability, the density of businesses or services, pedestrian facility availability, retail floor area ratio, perceived environmental supports, and Walk Score™. The most common approach is to combine walkability indicators into a single index, though a handful of studies analyze walkability components separately. Researchers usually create walkability indicators using GIS software and available geographic data; however, in one instance, survey respondents were asked their perceptions of environmental supports for walking (Hooker, Wilson, Griffin, & Ainsworth, 2005).

Walking and physical activity outcome variables also vary across the reviewed studies. The most common outcome variables are based on observed or self-reported behaviors such as minutes spent walking, walking trips, or minutes engaged in physical activity. Three of the public health studies convert physical activity into metabolic equivalents. The variables are continuous in some studies; other studies indicate whether recommended thresholds were met or not.

Evidence of a Weaker Built Environment Effect for Disadvantaged Groups

Thirteen of the 17 studies we review show at least some evidence of weaker built environment effects on walking and physical activity for disadvantaged groups than for advantaged groups. Of the four studies that do not find weaker built environment effects for disadvantaged groups, two find no difference in the relationship between the built environment and walking or physical activity and two find that, unexpectedly, disadvantaged groups were more responsive to walkable built environments. It is not clear why these studies disagree. Two of the four studies are from Belgium and New Zealand, so it is possible that factors related to urban structure, income inequality, social safety nets, or the presence or distribution of urban poverty in these countries play a role. We do not see any patterns across the 17 studies that suggest that differences in the built environment effect were the result of the indicators of disadvantage, walking, or physical activity.

The subset of five studies that provides enough data to assess the magnitude and nature of the differences in the built environment effect together tests 15 different relationships between the built environment and transport walking, leisure walking, total miles walked, and physical activity for groups based on income, race/ethnicity, and educational attainment. Data from this subset of studies provide further evidence that there is a weaker built environment effect for disadvantaged groups and indicate that the difference is likely substantial.

Across the four transport walking comparisons, shown in Table 3 and illustrated in Figure 3, the average built environment effect for disadvantaged groups results in 70% more transport walking in supportive built environments than in unsupportive built environments. For advantaged groups, the built environment effect results in 183% more walking than in the unsupportive built environment. This means that the average built environment effect on transport walking for advantaged groups is 2.6 times stronger than it is for disadvantaged groups.

Built environment effects for physical activity and leisure walking, also shown in Table 3 and illustrated in Figure 3, are considerably smaller than for transport walking, but the pattern of a stronger built environment effect for advantaged groups remains. The average built environment effect on physical activity for advantaged groups is 27% compared with 11% for disadvantaged groups. The built environment effect on leisure walking is just 6% for advantaged groups and less than 1% for disadvantaged groups. The weaker built environment effect for leisure walking makes sense because this behavior can occur independent of destination availability, which is a common indicator of a walkable built environment.

The average effect of the built environment across all 15 relationships tested in these five studies is 30% for disadvantaged groups and 69% for advantaged groups. The median values are 18% and 47%, respectively. This suggests that the strength of the built environment effect is between 2.3 and 2.7 times stronger for advantaged groups than for those who are disadvantaged. Because of the small subset of studies from which these values were calculated, our findings must be interpreted with caution.

Eleven of the 15 relationships tested in this subset of studies show, as expected, a greater built environment effect for the advantaged group than the disadvantaged group. The exceptions to this are all in the Forsyth et al. (2009) study, which has mixed results. Consistent with most of the other studies, the built environment effect on transport walking (by race/ethnicity) is −34% for the disadvantaged group and 132% for the advantaged group, whereas leisure walking and distance walked show the built environment effect reversed regarding race/ethnicity. It is not clear from the data why Forsyth et al.'s findings would differ from the other studies, but it could have to do with the use of a simpler built environment indicator consisting of residential density and block size.

Data from this subset of studies also allow us to test our assumption that weaker built environment effects for disadvantaged groups are the result of both more walking and physical activity than advantaged groups in unsupportive built environments and less walking and physical activity than advantaged groups in supportive built environments. Although we find some evidence to support both assumptions, it appears that differences in the built environment effect between disadvantaged and advantaged groups are more likely to be caused by disadvantaged groups walking less in supportive built environments. Eleven of the 15 relationships tested show that disadvantaged groups walked less in supportive built environments compared with just a handful that show more walking by disadvantaged groups in unsupportive built environments.

The limitations of our review largely have to do with the challenge of synthesizing a relatively small number of studies that are from two different academic disciplines, use different methods and measures, and only sometimes provide enough clarity to make good comparisons. We have previously noted that our quantitative analysis of the smaller subset of studies should only be used to get a general idea of the phenomenon we are exploring. This is especially true for the estimates of the advantaged to disadvantaged built environment effect ratio for specific types of walking or physical activity, which are based on as few as four data points. Far more research on this question needs to be conducted before anything resembling a true meta-analysis can be conducted.

What Does a Weaker Built Environment Effect on Walking and Physical Activity for Disadvantaged Groups Mean for Planning Research and Practice?

Here we provide evidence that across a diversity of studies from planning and public health the pattern of relationships between the built environment and walking and physical activity is stronger for those who are relatively socioeconomically advantaged and weaker for those who are socioeconomically disadvantaged. We also show that the weaker effect of the built environment on disadvantaged groups appears less likely to be the result of more walking and physical activity occurring out of necessity in unsupportive built environments, though that is the case in a handful of studies. Instead, the more likely explanation for the difference in the built environment effect is that disadvantaged groups are, for many reasons, less likely than advantaged groups to as fully realize the potential of walking, physical activity, and related health benefits of supportive built environments for walking.

Our review suggests that the inattention of planning scholars to socioeconomic differences in the effects of the built environment may have led to recommendations for planning practitioners and policymakers that resulted in benefits accruing to some more than others. In some neighborhood contexts, such recommendations may have overstated the benefits of walkable built environments and overlooked the need for strategies beyond built environment interventions.

Lessons for Planners

Transportation planners are well equipped to address deficiencies in the supports in the built environment for walking, though resources and equitable distribution of those resources is another story. Walking in unsupportive built environments presents many challenges in terms of safety, convenience, time, and comfort (Loukaitou-Sideris, Liggett, & Sung, 2007; Stoker et al., 2015). The combination of higher exposure rates and deficient infrastructure in this context may contribute to higher pedestrian injury and fatality rates seen in disadvantaged areas. These are challenges that transportation planners are equipped to address in a relatively straightforward way. Where clear deficiencies in the built environment exist, planners have many strategies with strong empirical support and confidence so that, given the necessary resources, targeted investments in infrastructure improvements will improve conditions for those already walking and should increase the feasibility, comfort, and safety of walking enough that walking rates may increase further over time. Investments under these conditions are likely to address fundamental pedestrian needs, such as basic infrastructure and safety improvements.

Addressing barriers to walking in the context of an already supportive built environment presents a more vexing challenge, as planners may be ill equipped to address social, household, and individual constraints on behavior and choice, such as crime, childcare limitations, and feelings of exclusion. In a scenario in which characteristics of the social environment, such as high crime rates and disorder, are suppressing the effect of a supportive built environment for walking, efforts by planners to further improve the built environment will likely not address underlying barriers to walking and may be at odds with more immediate community needs and priorities, particularly in the short term. Investment in physical solutions that fail to address these other community priorities related to the social and economic environment may lead to pushback and distrust, particularly in areas that may be accustomed to nonresponsiveness to community needs or a history of disinvestment (Miller & Lubitow, 2014). This misalignment of planning goals and community needs and priorities may further contribute to distrust between planners and residents—especially in neighborhoods facing displacement pressures—and send a message to existing residents that planned walkability improvements are for the benefit of future residents.

Key Recommendations for Planners

Our biggest intended takeaway for practicing planners is quite simple, despite the nuance discussed in this review: Recognize in your work that the benefits of walkability may not accrue equally across a city. Our exploration of the larger set of issues surrounding differences in built environment effects across socioeconomic contexts allows us to formulate several specific recommendations for practice that could more effectively remove barriers to walking in all contexts:

1. Recognize that the effects of the built environment on walking and physical activity likely vary by socioeconomic context.
2. Use social ecological frameworks to plan for holistic approaches to improving walkability.
3. Expand definitions of walkability beyond attributes of the built environment to include other types of barriers (and perceived barriers) to walking.
4. Partner across silos within planning as well as with other professions and sectors, including community-based nonprofits, to address the social environment and economic development.
5. Evaluate and monitor interventions and investments in different socioeconomic contexts.

Lessons for Research

Our review contributes to a better understanding of differences in the effect of the built environment by socioeconomics. It remains clear, however, that there is a need for planning and public health researchers to further validate walkability metrics in different socioeconomic contexts. Most researchers who explicitly set out to investigate differences in built environment effects by socioeconomic disadvantage were not from planning. And even fewer were publishing their work in planning journals. So for planning researchers, there is a clear responsibility to test built environment characteristics related to walking and physical activity across different socioeconomic contexts by using methods similar to those of the studies we have identified in this review. In many cases, it may be possible to revisit existing data sets, many of which already include socioeconomic variables, and reanalyze them with a goal of explaining differences in built environment effects across socioeconomic contexts rather than simply controlling for those differences. The sizable evidence base pointing to built environment relationships with walking and physical activity has helped guide billions of dollars in investments and shifted policy at the federal, state, and local levels toward supporting walkable communities. The next generation of this research tradition must better contextualize walkability in ways that help planners support walking and physical activity for everyone.

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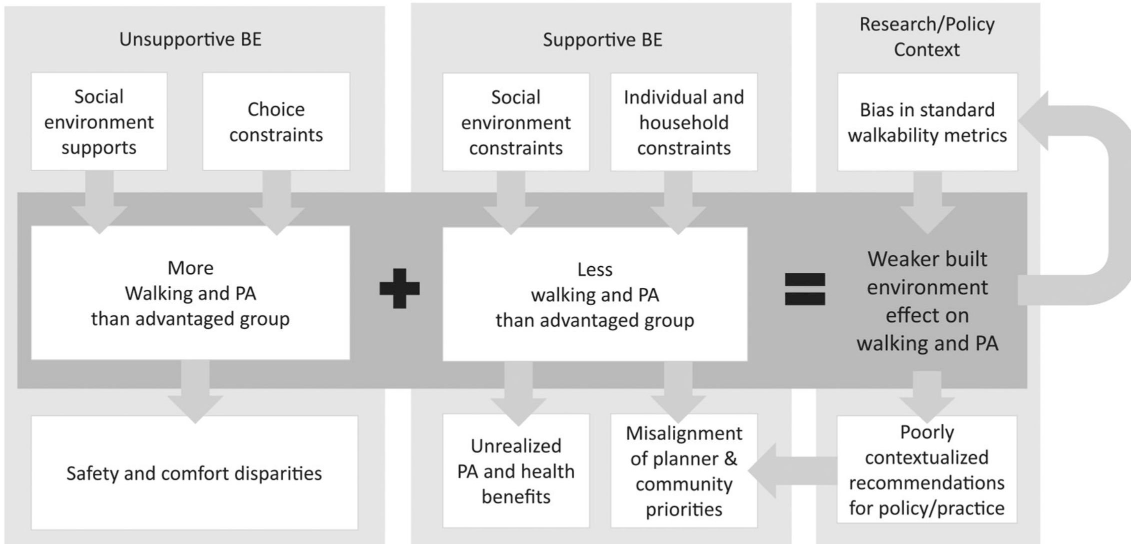

Figure 1.

Conceptual framework showing factors that contribute to weaker built environment (BE) effects on walking and physical activity (PA) among disadvantaged groups.

	Weekly minutes of walking in **unsupportive** built environments	Weekly minutes of walking in **supportive** built environments	Built environment effect (min)	Built environment effect (percent)
Advantaged (high-income)	10.5 min.	53.5 min.	+ 43 min.	410%
Disadvantaged (low-income)	15.6 min.	36.2 min.	+ 20.6 min.	130%

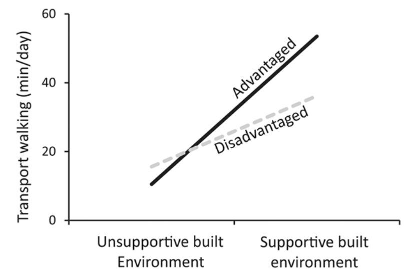

Figure 2.

Tabular and graphical illustration of differences in the built environment effect with sample data for transport walking from Sallis et al. (2009).

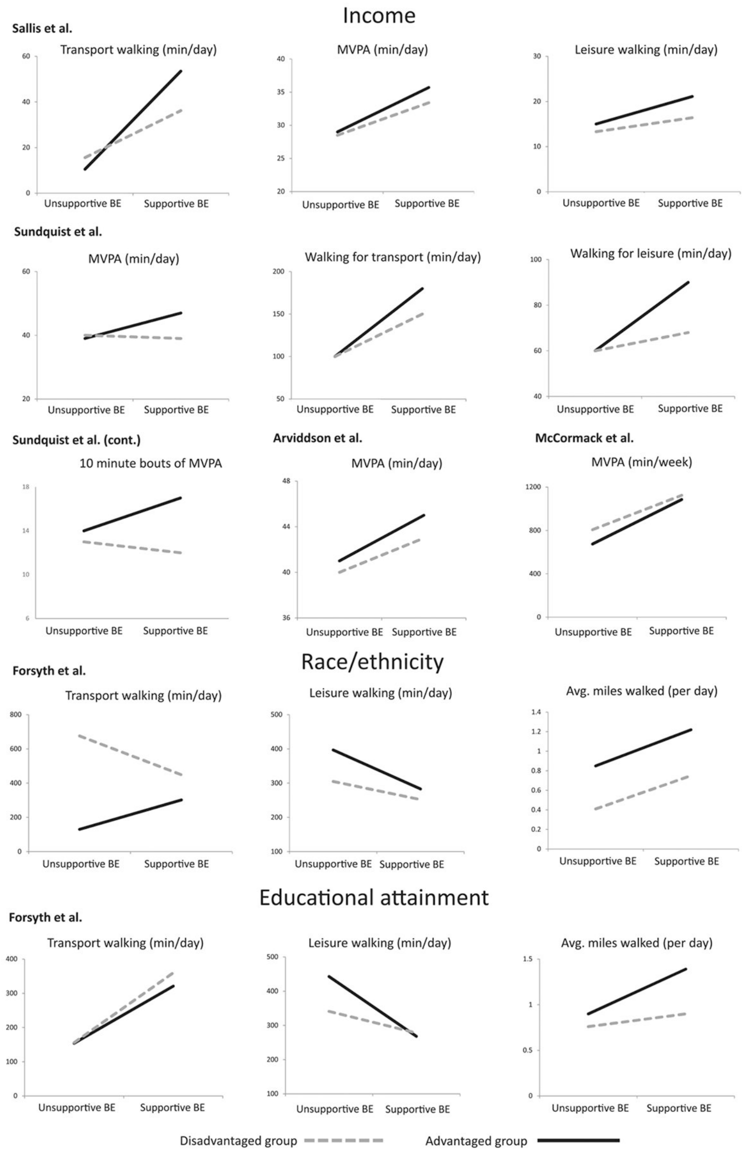

Figure 3.

Illustration of BE effects on walking and physical activity; the amount of walking or physical activity in unsupportive and supportive BEs. Note: MVPA = moderate to vigorous physical activity; BE = built environment; Avg. = average.

Table 1.

Search term combinations used to identify articles.

Socioeconomic context	Physical activity outcome	Built environment
Disadvantage	Walking	Walkable
Low-income	Physical activity	Built environment
Racial minorities	Active transportation	Neighborhood
Black	Pedestrian	Urban form
Hispanic/Latino	Health	Urban design
Socioeconomic status		Infrastructure
Poverty		Land use

Table 2.

Summary of studies included in the systematic review.

Study basics	Walking or PA variable	Built environment measure	Indicator of disadvantage	Evidence of weaker built environment effect for disadvantaged groups	Description of difference in built environment effect on walking and PA
Arvidsson et al. (2013) Discipline: Public health Geography: Stockholm (Sweden) Population: Adults Sample size: 2,252	PA (continuous)	Index: residential density, street connectivity, land use mix	Income[a]	Yes	"Living in a high walkability neighborhood was associated with more MVPA compared with living in a low walkability neighborhood…However, for those participants with low incomes, the P values were >0.05, although a tendency was seen with a possible association between neighborhood walkability and MVPA" (p. 698).
Forsyth et al. (2009) Discipline: Planning Geography: Minneapolis (MN) Population: Adults Sample size: 716	Walking for transport, leisure walking, total miles walked	Residential density, median block size	Race/ethnicity, education[a]	Mixed	"A number of other findings were close to significance with several groups walking more in high density areas including whites, those without a college degree, the employed, those with cars, and the obese" (p. 45).
Frank et al. (2004) Discipline: Public health Geography: Atlanta (GA) Population: Adults Sample size: 10,878	Time spent in car, distance walked, BMI	Connectivity, residential density, land use mix	Race[a]	Yes	"The strongest association between urban form and BMI was for white males." "Walk distance was positively associated with all three urban form variables for whites, while land use mix and intersection distance were positively associated with walk distance for black females. No linear relationships were found between urban form and walk distance for black males" (p. 93).
Frank et al. (2008) Discipline: Public health Geography: Atlanta (GA) Population: Adults Sample size: 13,065	Any walking trips over 2-day period (dichotomous), obesity	Residential density, street connectivity, land use mix	Income, race/ ethnicity,[a] education[a]	Yes	"Men without a degree, unemployed, and non-white were more likely to be obese if they lived in highly connected neighborhoods as were white women without a degree who lived in more dense neighborhoods. These two results may be due to crime and other social factors in the most urban settings in Atlanta" (p. 177).
Freeman et al. (2012) Discipline: Public health Geography: New York City (NY) Population: Adults Sample size: 8,064	Zero episodes of active travel (binary), number of episodes of active travel (continuous)	Index: residential density, intersection density, subway station density, land use mix, ratio of retail building floor area to retail land area	Income,[a] race/ ethnicity[a]	Yes	"Associations between lower walkability and reporting zero episodes of active travel were significantly stronger for non-Hispanic Whites as compared to non-Hispanic Blacks and to Hispanics and for those living in higher income zip codes" (p. 575).
Hooker et al. (2005) Discipline: Public health Geography: Rural South Carolina Population: Older adults Sample size: 1,165	At least 150 min PA (binary)	Perceived environmental supports	Race/ethnicity[a]	Yes	"These data indicate that perceptions of certain social and safety-related environmental supports were strongly associated with meeting the recommendations for PA and walking among white but not African American adults" (p. 1).
Ivory et al. (2015) Discipline: Public health Geography: Auckland, Wellington, and Christchurch (New Zealand) Population: Adults	PA (average accelerometer counts per hour)	Streetscape, neighborhood destinations, street connectivity	Income	No (opposite effect)	"For example, our findings showed that the built environment-physical activity gradients were steeper across income and car access groups compared to gender and working status" (p. 238).

Study basics	Walking or PA variable	Built environment measure	Indicator of disadvantage	Evidence of weaker built environment effect for disadvantaged groups	Description of difference in built environment effect on walking and PA
Sample size: 2,033					
Kerr et al. (2007) Discipline: Planning Geography: Atlanta (GA) Population: Youth Sample size: 3,161	At least one walking trip over 2-day period (binary)	Intersection density, residential density, mixed land use (binary), at least one commercial land use (binary), at least one recreation space	Race/ethnicity,[a] income[a]	Yes	"In summary, urban form was not as significantly related to walking for non-whites, low-income groups and those with no car in the household" (p. 181).
Manaugh & El-Geneidy (2011) Discipline: Planning Geography: Montreal (Canada) Population: Adults Sample size: 17,395	Share of home-based trips by walking	Walkability index, Walk Score™, walk opportunities index	Income[a]	Yes	"Wealthy, car owning households are much more sensitive to elements of walkability than retired or low-income households" (p. 315).
McCormack et al. (2014) Discipline: Public health Geography: Calgary (Canada) Population: Adults Sample size: 2,006	PA within neighborhood	Cluster analysis based on street connectivity, density of businesses and services, density of bus stops, sidewalk length, mix of park types, mix of recreational facilities, population density, pathway/cycleway length, proportion of green space	Income, educational attainment	No (no difference observed)	"…this relationship between walkability and PA appears to exist regardless of the participants' sociodemographic and self-rated health characteristics" (p. 112).
Owen et al. (2007) Discipline: Public health Geography: Adelaide (Australia) Population: Adults Sample size: 2,650	Weekly frequency of walking for transport	Walkability index composed of housing unit density, street connectivity, land use mix, and net retail area	Educational attainment[a]	Yes	"Educational attainment moderated the relationship between weekly frequency of walking for transport and neighborhood walkability. There was no significant effect of neighborhood walkability on frequency of walking for transport in respondents with 10 or less years of education. In contrast, a positive significant association was found between walkability and frequency of walking for transport in respondents with 12 or more years of education" (pp. 391–392).
Pan et al. (2009) Discipline: Public health Geography: Canada (national sample) Population: Adults Sample size: 5,167	PA (continuous), metabolic equivalent	Facility availability	Educational attainment[a]	Yes	"Facility availability was more strongly associated with PA among people with a university degree than among people with lower education level" (p. 1).
Sallis et al. (2009) Discipline: Public health Geography: Seattle (WA) and Baltimore (MD) Population: Adults Sample size: 2,197	PA	Index: intersection density, residential density, retail floor area ratio, land use mix	Income[a]	Yes	"Walking for transportation was significantly higher in high-walkability neighborhoods compared to low-walkability neighborhoods; however, the differential was larger in high-income neighborhoods (5.1 min) vs. low-income neighborhoods (2.3)" (p. 1288).
Steinmetz-Wood & Kestens (2015) Discipline: Public health	Walking trip (binary)	Connectivity, land use mix, density of businesses and services	Income[a]	Yes	"Trips in the highest quartiles of connectivity and density of businesses and services were found to have a weaker association

Study basics	Walking or PA variable	Built environment measure	Indicator of disadvantage	Evidence of weaker built environment effect for disadvantaged groups	Description of difference in built environment effect on walking and PA
Geography: Montreal (Canada) Population: Adults Sample size: 156,700					with active transportation if the individual undergoing the trip was from a low SES neighborhood" (p. 262).
Sundquist et al. (2011) Discipline: Public health Geography: Stockholm (Sweden) Population: Adults Sample size: 2,269	PA	Index: residential density, street connectivity, land use mix	Income[a]	Yes	"The logistic part shows that the odds for walking for active transportation were 92% higher among individuals who lived in highly walkable neighborhoods than among those living in less walkable neighborhoods. After including neighborhood-level SES and the individual-level variables, the odds decreased to 1.77 (i.e. 77% higher odds) but remained significant" (p. 1271).
Van Dyck et al. (2010) Discipline: Public health Geography: Ghent (Belgium) Population: Adults Sample size: 1,166	PA	Index: residential density, street connectivity, land use mix	Income	No (no difference observed)	"For the moderating effects of neighborhood SES on the relationship between walkability and the physical activity behaviors, no significant results were found" (p. S77).
Van Holle et al. (2014) Discipline: Public health Geography: Belgium Population: Older adults Sample size: 438	PA (binary)	Index: residential density, street connectivity, land use mix	Income	No (opposite effect)	"A walkability × income interaction was found for accelerometer-derived MVPA ($B = -1.826 \pm 1.03$; $p = 0.075$), showing only a positive association between walkability and MVPA in low-income neighborhood residents" (p. 1).

Note: PA = physical activity; MVPA = moderate to vigorous physical activity; BMI = body mass index; SES = socioeconomic status.

[a] Indicates differences.

Table 3.

Subset of studies demonstrating the magnitude of the difference in built environment effect.

Study (organized by type of walking or PA)	Built environment effect for disadvantaged	Built environment effect for advantaged
Transport walking		
Built environment effect by income (Sallis et al.)	132%	410%
Built environment effect by income (Sundquist et al.)	50%	80%
Built environment effect by race/ethnicity (Forsyth et al.)	−34%	132%
Built environment effect by education (Forsyth et al.)	131%	108%
Average built environment effect on transport walking	70%	183%
Advantaged to disadvantaged effect ratio for transport walking		2.6:1
Physical activity		
Built environment effect by income (Arvidsson et al.)	8%	10%
Built environment effect by income (McCormack et al.)	39%	61%
Built environment effect by income (Sallis et al.)	17%	23%
Built environment effect by income (Sundquist et al.): bouts	−8%	21%
Built environment effect by income (Sundquist et al.): minutes	−3%	21%
Average built environment effect on physical activity	11%	27%
Advantaged to disadvantaged effect ratio for physical activity		2.6:1
Leisure walking		
Built environment effect by income (Sallis et al.)	23%	41%
Built environment effect by income (Sundquist et al.)	13%	50%
Built environment effect by race/ethnicity (Forsyth et al.)	−17%	−29%
Built environment effect by education (Forsyth et al.)	−18%	−40%
Average built environment effect on leisure walking	0.3%	6%
Advantaged to disadvantaged effect ratio for leisure walking		24:1
Other		
Built environment effect by race/ethnicity (Forsyth et al.): distance	83%	44%
Built environment effect by education (Forsyth et al.): distance	18%	54%
Total		
Unweighted average built environment effect	30%	69%
Median built environment effect	18%	47%

Study (organized by type of walking or PA)	Built environment effect for disadvantaged	Built environment effect for advantaged
Advantaged to disadvantaged effect ratio (based on mean)		2.3:1
Advantaged to disadvantaged effect ratio (based on median)		2.7:1