Does the Built Environment Matter for Physical Activity?

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There has been a dramatic increase in the number of studies that correlate aspects of the built environment with physical activity. Several publications have summarized the state of the field and have made recommendations on how to move the field forward. This paper describes some of the recommendations and reports on recent progress that has been made on them. Specific issues that are addressed are causality, perceived versus objective environmental measures, definitions of a neighborhood, use of audit instruments, and cost–benefit studies.

Introduction

The past decade has seen a proliferation of research that examines the relationship between physical activity and the built environment. The built environment is defined as the physical form of communities including, for example, land use patterns, parks, and transportation systems. Characteristics of the built environment that have been examined in relation to physical activity can be broadly grouped as recreational resources, land use, neighborhood form, and community environment [1]. Recreational resources include trails and parks; land use includes residential density, mix of business types, street connectivity, and proximity to shops; neighborhood form includes the availability of sidewalks and streetlights; and community environment includes crime, aesthetics, cleanliness, and social cohesion.

Many positive associations have been reported for each of these broad categories (eg, recreational availability [2–6], land use [7–12], neighborhood form [6,8,10,13], and community environment [10,11,13–19]), but many null results also have been found [8,11,13,17,19–21]. Several recent reviews have concluded that most studies examining the built environment and physical activity have had null associations [22,23]. In fact, one review of studies in adults reported that 75% of the studies examined did not find a relationship between physical activity and some aspect of the built environment [23]. The authors of these reviews suggest that poor measurement and methodology may be partly responsible for the inconsistent and null findings. Indeed, early work had substantive methodologic and theoretical limitations, as might be expected in a burgeoning field. Recent studies have begun to address these limitations, resulting in more nuanced research. In addition, several reports and publications have provided reasoned reflection on what will constitute the next generation of research. This paper describes several of the recent recommendations for advancing the field and provides highlights of recent progress that has been made on these recommendations.

Establishing Causality

The major challenge facing research that examines the built environment and physical activity is establishing causality. While providing evidence for causality is a challenge in most research, studies of the built environment are particularly plagued by the issue of self-selection [1,24,25••]. Most research to date cannot differentiate whether the built environment leads to increases in physical activity or whether people self-select into neighborhoods conducive to activity. The latter can result in a spurious association between the built environment and physical activity, and it may occur because people who value walking may choose to live in walkable neighborhoods or because those who like to use parks may choose to live in locations with easy access to parks. Giles-Corti et al. [26•] found this to be true in adults who were planning to move in the next 2 years. Those who preferred walkable neighborhoods were more likely to plan to move to neighborhoods that had features consistent with that preference. However, the levels of walking in those with this preference were not different from those who planned to move to more conventional neighborhoods.

To address the issue of self-selection, researchers have called for study designs beyond cross-sectional studies, such as natural experiments, longitudinal studies, or analyses that statistically control for self-selection [1,24,27]. Natural experiments are defined by at least two features: 1) the change or natural experiment that

occurs is a result of processes in the social and political world (versus investigator initiated) and is often sudden and 2) intervention versus control status is not defined by the investigator [28]. Although several studies of natural experiments have been completed recently, more studies are needed. Results from the completed experiments are mixed. Wells and Yang [29•] followed 32 women who moved through the Habitat for Humanity program into neotraditional neighborhoods (eg, compact communities conducive to walking and biking) or conventional suburban neighborhoods. Because only one neighborhood type was built in each region, participants were not given a choice of neighborhood. Those who moved into neotraditional neighborhoods were not more likely to increase their walking than those who moved to conventional neighborhoods. Those who moved to locations with fewer cul-de-sacs than in their previous location engaged in more walking.

In a study of renovated playgrounds, Colabianchi et al. [30•] found that 10 renovated playgrounds attracted more users than 10 matched control playgrounds. Children, particularly boys, at the renovated playgrounds were more likely to be vigorously active. The playgrounds were located in an urban area in the Midwest, and each had undergone about $200,000 worth of renovations. Finally, Brown and Werner [31••] examined bouts of moderate activity as measured by accelerometry before and after the opening of a light-rail stop. Increases in moderate activity at follow-up were associated with use of the light rail (after controlling for baseline activity). The walk to or from the rail stop was responsible for only a part of the moderate activity; hence the use of the light rail may have increased other walking as a means of transportation during the day (ie, walking to get lunch).

An exciting natural experiment that is currently being evaluated is the Residential Environments Project (RESIDE) [26•]. This study will follow 1813 people in Perth, Western Australia, who are moving into 74 new housing developments. These developments include "livable developments," defined as neighborhoods that are pedestrian friendly with convenient access to shops, transit, and parks; hybrid developments, which have some but not all features of livable developments; and conventional housing developments. Baseline data have already been collected.

Given the limited number of natural experiments that have been completed and the diverse environments and outcomes that have been examined in these studies, many more natural experiments are needed before conclusions can be drawn about whether these studies support the association between the built environment and physical activity. One of the challenges of completing natural experiments is that the researcher is not in control of the environmental changes and external funding cycles have generally not been flexible enough to support the quick and flexible funds needed to evaluate these opportunities. This recently changed with initiation of the Active Living Research and Healthy Eating Research Rapid Response Grants (a national program of the Robert Wood Johnson Foundation). These grants are intended to support, "time-sensitive, opportunistic studies to evaluate changes in policies or environments" (http://www.activelivingresearch.org/grantsearch/grant-opportunities/current). Similarly, the Canadian Institutes of Health Research's grant mechanism supports "the prompt initiation of intervention and evaluation research on rapidly unfolding programs, events, and/or policy initiatives/changes with the potential to impact healthy living and/or chronic disease prevention at the population level" (http://www.cihr-irsc.gc.ca/e/36730.html). The availability of these funds should increase the number of studies that use this design.

Although only a few results from longitudinal studies have been reported since mid 2007, many more longitudinal studies are in the works (eg, HABITAT, ENDORSE [32,33]). The most instructive longitudinal studies are those in which the participants experience an environmental change (ie, they move or the environment was modified), but longitudinal studies in the absence of change will provide better evidence for causality than a cross-sectional study because the exposure precedes the outcome. A recent longitudinal study examining physical activity levels is the Children Living in Active Neighbourhoods study [34]. The investigators found evidence of a longitudinal relationship between physical and social environments and walking behaviors among the mothers they studied. Trusting local people, satisfaction with the quality of local features, and public transport were associated with increases in walking for leisure. Practical features such as connectivity and road safety as well as the quality of local facilities and having sports venues were associated with increases in walking for transport.

The best evidence from longitudinal studies is from studies of people who have moved, thereby modifying their exposure. However, no studies since July 2007 measured physical activity as a consequence of the environment in movers over time. One study did examine self-reported physical activity levels before and after a move; both were measured at follow-up. This study found that changes in neighborhood safety, physical activity options, socializing (people out and interacting; diversity), and attractiveness of the neighborhood were associated with increases in physical activity levels [35•].

Finally, research that incorporates statistical controls for self-selection have been suggested to help address self-selection bias [25••]. A variety of statistical controls are available; for example, direct questioning allows one to know whether the person moved because of a preference for the environment, but it does not allow for quantitative adjustments. Another option is to collect a series of attitudinal questions about travel choices and residential choices and to control for these in the analyses. An extension of this is to compare levels of activity in participants who live in neighborhoods that match their preferences and those who do not.

A few recent studies have incorporated statistical controls that measured preference for neighborhood type. Handy et al. [35•] asked participants the importance of 34 characteristics of the neighborhood when deciding to move (for movers) and if they were important for a future move (for nonmovers). These preferences were controlled for in the analyses, but none of the preferences were significant in models that predicted neighborhood physical activity levels (cross-sectional) or changes in neighborhood physical activity levels (quasi-longitudinal).

Frank et al. [36•] published another interesting study that explicitly controlled for neighborhood preference. They classified about 900 people into the following categories: 1) prefers and lives in a high-walkable neighborhood; 2) prefers a high-walkable neighborhood and lives in a low-walkable neighborhood; 3) prefers a low-walkable neighborhood and lives in a high-walkable neighborhood; 4) prefers and lives in a low-walkable neighborhood. Among those who preferred high-walkable neighborhoods (categories 1 and 2), the number of people who walked for any purpose or for nondiscretionary purposes was double for those who lived in high-walkable neighborhoods (category 1) versus low-walkable neighborhoods (category 2). The proportion that walked for discretionary purposes was four times as high among those living in high-walkable neighborhoods. Among those who preferred low-walkable neighborhoods (categories 3 and 4), the proportion that walked for any purpose was low regardless of the neighborhood type in which they lived. This study suggests that self-selection is not the only reason for the association between the environment and physical activity even though it does play an important role. It seems that the environment facilitates activity among those with a preference for walkable neighborhoods but has little effect on those who prefer low-walkable neighborhoods.

Perceived Versus Objective Environmental Measures

Another major issue that needs to be resolved is whether it is better to examine perceived (or subjective) environmental attributes or attributes determined objectively (eg, via an audit of the neighborhood). Most of the research has examined perceptions from self-reported data [37]. Several studies have included both perceptive and objective measures and found little correspondence. Most had κ statistics of less than 0.4, indicating very poor agreement [37]. Some have argued that perception is reality and hence that subjective reports are superior. However, it is difficult to determine whether the association between perception of available resources and physical activity is a consequence of active people being more aware of what physical activity resources are available nearby. In other words, active people would report a greater number of resources nearby whereas nonactive persons living in the same area would report fewer resources, resulting in a spurious relationship between availability of resources and physical activity levels.

A recent study examined not only the degree of mismatch between perceived reports of physical activity facilities versus objective accounts but also whether the mismatch was correlated with sociodemographics, attitudes, self-efficacy, and/or behavior [38••]. Consistent with most other studies, there was poor to fair correspondence between the perceived and objectively assessed facilities (κ 0.03–0.39) with the exception of the availability of the coast, which had high agreement. Importantly, women who were physically active were less likely to have discordance between objective and perceived reports of facilities, supporting the notion that more active people may be more aware of available resources. Similarly, the mean number of facilities used was lower among those with a mismatch between perceived and objective reports. Finally, age, income, time in the neighborhood, and enjoyment of walking were all correlated with the degree of mismatch. The authors concluded that future studies that aim to correlate actual environments with physical activity should use objective data because there was such a low correspondence between perceptions and objective reports. When using self-reported perceptions of the environment, researchers should control for the likely systematic bias by controlling for attributes that are known to be associated with mismatch.

Other recent reports have suggested measuring both objective and perceptive attributes, particularly those attributes with very poor correspondence between perceptive and objective data (eg, convenience, aesthetics, safety) [1,37]. Importantly, subjective assessments of the environment may be associated with physical activity, but the causal ordering may be reversed; in other words, being physically active (in particular, walking) may influence one's perceptions.

Defining the Neighborhood

An important issue that has received surprisingly little attention is the definition of a neighborhood. Most studies of the built environment require the researcher or participant to define the number of features that are accessible within their neighborhood, but various definitions of neighborhoods are used. Neighborhoods are sometimes self-defined by the participants: they are asked whether they have specific features, such as a park, within their neighborhood, but no definition of neighborhood is provided to them. Neighborhoods are often defined as being within the boundaries of a 10- to 15-minute walk. This metric is supported by research examining a reasonable walking distance, at least in adolescents, who defined an easy walking distance as 15 minutes [39]. The most commonly used definition of a neighborhood in US-based neighborhood research is the participant's census tract as defined by the US Census Bureau [40]. Many researchers have noted that census tract boundaries are unlikely to

comport with actual definitions of one's neighborhood. Finally, buffers around a participant's home are also often used in research of the built environment. Buffers could be drawn as a euclidean distance (ie, as the crow flies) or as a network buffer, which would follow the road network. The former is usually used [41]. The choice is important because the two can represent very different neighborhoods, especially in rural areas with limited roadways and connectivity. Buffers have been drawn at multiple distances (0.1 km [42] [0.06 miles] to 5 miles [5]), but buffers around a half mile or 1 mile seem to be the most common [43–48].

Researchers have varied buffer sizes in an attempt to determine which buffer is appropriate. For example, McCormack et al. [49••] examined the relationship between destination mix and various types of physical activity using buffers of 400 meters and 1500 meters, which approximated 5- and 15-minute walks. The authors stated that larger buffers may be needed for less common destinations and smaller buffers could be used for more common destinations. They argued that because transportation-related destinations are generally closer than recreational destinations, smaller buffers may be more appropriate for the former relative to the latter. Similarly, Brownson et al. [37] speculated that the appropriate buffer may depend on the behavior of interest and the population being studied. Given the importance of this issue, much more research is needed.

Use of Audit Instruments

To successfully examine the built environment, valid and reliable audit instruments are needed. Many audit instruments have been developed in recent years [50–55]. This is likely, at least in part, a result of the Robert Wood Johnson Foundation's Active Living Research program, which focused funding on the development of reliable instruments. Despite the creation of these audit instruments, there are few published results from studies that have used them. Recent exceptions include studies by Colabianchi et al. [30•] and Kaczynski et al. [56••], who both used the Environmental Assessment of Public Recreational Spaces (EAPRS).

Kaczynski et al. [56••] examined park use at 33 parks. Using the EAPRS to characterize the facilities, amenities, condition, and cleanliness of these parks, they examined which features were associated with park use. Because there was little variability in cleanliness and condition across the 33 parks, these attributes were not examined. Parks with more features (amenities and facilities combined) were more likely to be used for physical activity. Facilities were more important than amenities, and the presence of trails had the strongest association with use of a park for physical activity. Colabianchi et al. [30•] used the EAPRS to describe playgrounds but have not to date associated the playground features with utilization or activity levels. Both researchers greatly condensed the numerous variables measured in the EAPRS into a handful of variables. Additional research is needed to streamline the number of attributes for which data are collected by either systematically determining that there is no significant relationship between the attribute and physical activity or by developing appropriate ways to summarize the attributes from these audits, which can number in the hundreds.

Cost–Benefit Studies

An important question remains to be answered: assuming an association between the built environment and physical activity, are the economic savings sufficiently large to justify the costs of the infrastructure changes? The few recent studies that have projected the economic impact have found large savings in medical costs, but the savings were not as large as the costs of the infrastructure changes. Stokes et al. [57••] found that light-rail transit could result in health care savings of $12 million over 9 years, but the estimated construction costs of the light rail was $427 million. Another study estimated that public transit use could be associated with medical savings of about $5500 per person [58••]. Of course, savings in health care should not be expected to cover the complete costs of the infrastructure changes because the infrastructure is important for other reasons and has other benefits (ie, economic development, reduced congestion and pollution). Further, the health savings calculated to date focus only on physical activity and obesity, but they likely would span other health outcomes (ie, asthma, reduced injury). Additional studies that consider the economic benefits of built environment changes are needed. In particular, Heath Impact Assessments, which consider the range of health benefits, should be completed.

Conclusions

The evidence for the association between the built environment and physical activity is in its early stages. At this point, there is little evidence of a causal association. Recent studies have started to address the major limitations of this research, most notably self-selection bias and measurement issues. Future research needs to continue to address these concerns and to determine whether the effects are sufficiently large enough to justify the expense of the changes to the built environment. In addition, research needs to identify which attributes of the built environment are associated with physical activity and which factors are conducive to modification. Even in light of the limitations in the research and contradictory findings, many reports have recommended moving forward with changes in the built environment in anticipation of positive behavioral impacts [22].

Disclosure

No potential conflict of interest relevant to this article was reported.

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