



Physical Activity and the Built Environment

Development of a New Field of Research

September 2003 can be considered the public launch of the study of built environment and physical activity. In that month both the *American Journal of Public Health* and *American Journal of Health Promotion* published special issues on built environment, physical activity, and health. A notable characteristic of the journals was the unusual diversity of academic disciplines represented, including public health, behavioral sciences, urban planning, transportation, leisure studies, landscape architecture, economics, and law. One of the studies received massive media coverage introducing a new topic to the American public and the physical activity field.¹

Studying the built environment requires researchers to move beyond psychosocial models that guide individual behavior change strategies to broader ecological models. Ecological models teach that behavior has multiple levels of influence, including biological, psychological, social/cultural, physical environment, and policy factors. Change strategies are likely to be most effective when they alter all of those factors.² Intervening on multiple levels means changing people and environments. Interest in environmental and policy change as a public health priority was accelerated by concern about the obesity epidemic. Several authors identified environmental and policy change as the only feasible approach to creating massive population changes in physical activity and dietary behaviors needed to halt the obesity epidemic.^{3,4} However, a lack of data on the relation of environments and policies to behavior prevented an evidence-based approach, so filling research gaps became a priority.

Researchers in different fields from urban planning, geography, leisure sciences, psychology and public health were encouraged to form transdisciplinary teams by the CDC's (Centers for Disease Control and Prevention) Active Community Environments program. Since 2000, The Robert Wood Johnson Foundation's active living initiatives have stimulated rapid growth of the field by devoting over \$70 million to research, community demonstration projects, and policy change. The National Institutes of Health's and CDC's Obesity and Built Environment research program, spearheaded by the National Institute of Environmental Health Sciences, is contributing to the continuing growth of this field.

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This paper reflects three major trends in the field. First, the research comes from numerous disciplines that vary in the built environment factors and outcomes of interest. For example, urban planners have focused on the relation of overall community design to walking and cycling for transportation, while health and recreation researchers mainly were interested in how access to recreation facilities was associated with leisure-time activity. Second, more recently, transdisciplinary teams are blending their expertise to develop new methods to examine how multiple aspects of the built environment are related to total physical activity.⁵ Third, different aspects of the built environment are expected to be important for various subgroups, especially as defined by age, race/ethnicity, and socioeconomic status (SES).

Effects of Environmental Interventions

The strongest evidence of causal effects comes from randomized controlled trials, but there are no such studies of built environments.⁶ It is not possible for researchers to randomly assign either people or environmental interventions to specific places. There are several quasi-experimental evaluations that provide

evidence that changing built environments can change behavior. For example, in two studies introduction of a new trail appeared to increase physical activity,^{7,8} but another study found no effect.⁹ Adding markings to school playgrounds increased physical activity of children,¹⁰ and physical improvements around schools, such as adding sidewalks, improving street crossings, and slowing traffic, can stimulate more walking to school.^{11, 12} Studies assessing activity levels before and after major building projects are also underway in Australia, the UK, and Sweden.

Investigating environmental components in intervention studies that focused on individual change is also a promising strategy to strengthen the evidence. For example, intervention participants who reported higher levels of safety from traffic had greater improvements in physical activity than those with more concerns about traffic-related safety.¹³ Prospective studies monitoring change in perceptions of the environment will also add to the evidence.¹⁴ However, most of the studies dealing with built environment and physical activity are cross-sectional.

Community Design and Physical Activity

Urban planning and transportation researchers have been studying how community design affects travel behavior for several decades.¹⁵ They found people walked more when they lived in areas with two characteristics: mixed land use, in which homes, shops, and services are intermingled; and connected streets with frequent intersections and short blocks that provide direct routes for pedestrians. This general pattern of development is very common in older parts of the United States and around the world in places built before cars became the dominant mode of transportation. Such communities are referred to as “walkable,” meaning it is convenient to walk to several destinations. Sometimes other concepts are included in walkability, such as high residential density (often required to support neighborhood shops), sidewalks lining all streets, and buildings built right up to the sidewalk rather than having parking lots between the building and the street. The alternative low-walkable development pattern is seen mainly in communities built since the 1950s and is commonly referred to as the suburbs or sprawl. These places were designed to facilitate automobile travel. It is not possible for most people in the suburbs to walk for daily errands, and street patterns are disconnected, with many winding streets, long blocks, and cul-de-sacs.

Studies of Adults

Reviews of numerous studies in the urban planning literature consistently show people walk and cycle more

for transportation in high-walkable neighborhoods than in low-walkable areas.¹⁶⁻¹⁸ A typical difference of one walking trip per week translates into 30-60 more minutes of physical activity, and this difference should persist as long as the person lives in the same type of neighborhood. Mixed land use, street connectivity, and residential density are consistently supported as correlates of active travel, while presence of sidewalks has inconsistent results.

For the health field, a key question is whether walkability is related to total physical activity. Studies using objective accelerometer-based measures of physical activity demonstrate total physical activity is substantially higher among people living in high-walkable, compared to low-walkable communities.^{19, 20} These findings generally are supported whether built environments are measured by self-report,²¹ observational audits²² or using Geographic Information System (GIS) software.²³ However, findings are emerging that people’s perceptions of the environment may not match the objective data.^{24, 25} Thus, both are important to measure.

Studies on physical activity and community design were reviewed by panels from the Transportation Research Board and Institute of Medicine²⁶ and Task Force for Community Preventive Services.²⁷ Both groups concluded there is a consistent association between land use patterns and physical activity. Thus, land use is now accepted as an important issue for physical activity and public health. These groups recommended policy changes in zoning, development regulations, and transportation investments that would encourage development of more walkable communities.

Most studies focused on travel behavior or overall physical activity. More recent studies have compared different domains of activity, for example, walking for transportation versus recreation, and found specific community design attributes are related to each.²⁸⁻³⁰ This is an important research area because these studies can identify how to design communities that support several types of physical activity.³¹

Several limitations to this literature have been identified.^{26, 27} Because virtually all the studies are cross-sectional, there is the potential for self-selection bias in which results can be explained by physically active people choosing to live in neighborhoods where they can walk or bike to nearby destinations.³² Prospective studies that can follow people who move to different types of neighborhoods are needed. Another limitation is that most studies have been conducted on homogeneous samples or have not analyzed whether associations generalize across subgroups defined by sex, income, and race/ethnicity. Some studies have found built environment and physical activity were related in whites but not African

Americans,^{33, 34} which could be explained by lower levels of perceived safety in low income neighborhoods that could prevent residents from taking advantage of walkable neighborhoods.³⁵ Other studies have found gender differences.^{36, 37} An emerging finding is that psychosocial variables, such as attitudes, self-efficacy, and social support, explain much more variance in physical activity than does community design.³⁸⁻⁴⁰ One way to put this finding in perspective is that altering the built environment is likely to affect everyone living there on a relatively permanent basis, so even a small effect on an individual's behavior is multiplied across people and time.

Studies of Youth

Krizek proposed a model of the relevance of community design for youth physical activity.⁴¹ Though youth have different issues, such as commuting to school, access to play areas, and role of parents, many of the walkability associations with physical activity are presumed to be the same for youth and adults. Two studies using GIS measures of walkability and accelerometer measures of physical activity supported the relevance of walkability for adolescents.^{42, 43} In one study a walkability index explained about the same amount of variance as sex and ethnicity.⁴² However, a finding that higher street connectivity was related to lower activity levels in girls suggests that young people may use cul-de-sacs and suburban streets as play areas.⁴³ Thus, street connectivity could encourage walking for transportation while discouraging play.

Active commuting to school can contribute to overall physical activity,⁴⁴ and there appears to be a connection with community design. Kerr and colleagues found active commuting was higher in high-walkable neighborhoods, but this effect was seen for higher-income children only.⁴⁵ Braza et al. reported more active commuting to school in high density neighborhoods, but no relation to street connectivity.⁴⁶ Ewing and colleagues found more active commuting when sidewalks were present, but no association with density and land use mix.⁴⁷ A significant effect of sidewalks was replicated by Fulton et al.⁴⁸ McMillan confirmed high active commuting in walkable neighborhoods, but found other contributors, such as perceived safety, traffic, and attitudes.⁴⁹ Timperio and colleagues reported the surprising finding that higher street connectivity was associated with less active commuting.⁵⁰

The few studies of community design and youth physical activity generally support a positive association of walkability indicators with both walking to school and total physical activity. There is some evidence that poorly connected streets with less traffic could provide youth with places to play and may encourage active commuting to school. Many studies of youth benefit from objective

measures of physical activity.^{43, 51, 52} An important research priority is to examine how community design attributes may operate both similarly and differently for youth and adults.

Studies of Older Adults

Though it is likely the principles of walkability support walking for transportation among seniors, there are additional specific age-related issues in considering how to design activity-friendly communities. The design of the environment must take into account the declining acuity of senses.^{53, 54} Impaired hearing and vision need to be compensated for by louder crossing signals and increased lighting. Changes in gait and balance mean that hazards such as uneven sidewalks and high curbs need to be eliminated. Loss of stamina suggests more resting places are required. Interviews with seniors revealed having access to services was important so they could walk and take care of daily activities, thus maintaining their independence.⁵⁵ Frequent crosswalks with sufficient crossing time were a priority. Interviewees in one study indicated their choice of walking routes was influenced by length of route, sidewalk quality, people along the route, traffic, signaled cross walks, safety from crime, and scenery.⁵⁶

A few quantitative studies illustrate the potential for the built environment to support older adults' physical activity. In a Canadian study, physical activity was related to presence of hills, biking and walking trails, street lights, recreation facilities, seeing other people, and unattended dogs.⁵⁷ Li and colleagues found density, street connectivity, and safety were related to walking.⁵⁸ Patterson and Chapman reported women over 70 years old living in neighborhoods with mixed services and good pedestrian access to services walked more.⁵⁹ Studies using pedometers as objective measures of physical activity provide more convincing results. Older women living within a 20-minute walk of a park, trail, or store had more total steps than those with no destinations, and there was a direct relation between number of nearby destinations and number of steps.⁶⁰ In older overweight women, predominance of older homes (representing more pedestrian-friendly neighborhoods) and access to destinations were related to more walking.⁶¹

Maintaining independence is a major goal for seniors, and one study showed living in a mixed use neighborhood was associated with better ability to perform daily activities.⁶² The evidence linking community design and walkability factors with older adults' physical activity is limited, but results are consistent. Additional work is needed to document the specific design factors that are particularly important in creating activity-friendly communities for seniors.

Recreation Environments and Physical Activity

Researchers in the health, behavioral science, and leisure science fields have studied the relation of recreation environments and leisure-time physical activity for many years, but until recently the literature was very small. The main concept is that easy access to parks, trails, health clubs, and other places for physical activity could stimulate their use.⁶³

Studies of Adults

Humpel and colleagues reviewed the health literature on the environment and physical activity recently and found only 19 studies.⁶⁴ Only access to recreation facilities, access to opportunities (such as activity programs), and aesthetic factors were consistently associated with higher levels of physical activity. Godbey and colleagues summarized findings of leisure science research related to active living.⁶⁵ Parks are commonly used for a variety of physical activities, with walking being the most common. Distance to recreation facilities is strongly related to their use, and degree of naturalness was positively related to park use. Lee and Vernez-Moudon incorporated an urban planning and transportation perspective in their review of correlates of recreational physical activity.⁶⁶ They pointed out neighborhood sidewalks are a common place for recreational walks, so sidewalks may be important for both recreational and transportation physical activity. Trails can also be used for transportation and recreation purposes.⁶⁷

Recent studies have confirmed and expanded early results. Access to parks and trails is consistently related to activity levels,^{22, 23, 68-70} with few exceptions.⁷¹ The evidence is growing on the importance of aesthetics of recreation facilities and neighborhoods in general for walking,³⁹ running,⁷² and total leisure time physical activity.^{22, 69, 73} Presence and quality of sidewalks is emerging as an important correlate of leisure walking²⁹ and physical activity.⁷⁴ It is important to identify specific characteristics of recreation facilities that are strongly related to physical activity, because these findings can be translated into policies and design guidelines. Giles-Corti et al. identified people were very likely to walk in parks when they were nearby, large, and had a variety of attractive features.⁷⁵ Lindsey and colleagues reported the most used urban trails were in densely populated neighborhoods with mixed land uses and convenient parking.⁷⁶

It is clear that having easy access to parks and trails is associated with more walking and physical activity among adults. Sidewalks also play a crucial role in supporting physical activity. It appears people are more likely to use these facilities if they are aesthetically pleasing. Important research priorities are developing a better understanding

of how to build and equip parks and trails so they attract more people for regular physical activity.

Studies of Youth

In addition to their own yards, the main places where children are physically active seem to be the neighborhood streets and sidewalks, parks, and school grounds.^{77, 78} So it is not surprising an early review found proximity to recreation facilities and opportunities such as programs were consistent correlates of physical activity in children and adolescents.⁷⁹ Recent studies mainly have confirmed these early findings,^{52, 80-83} but some studies report significance only in some groups^{43, 84} or no significant associations.⁴² There is new evidence that proximity to schools and their activity facilities is related to physical activity.⁸⁵ New studies extended adult findings by showing aesthetics of recreation facilities and neighborhoods are related to youth physical activity.^{80, 83}

There is consistent evidence that children and adolescents with recreation facilities near their homes are more likely to be active than those with few facilities. One study showed quality of facilities was more important than simple proximity so examining the role of quality and amenities at public recreation facilities is a priority.⁸⁶ Because youth of different ages vary widely in common types of activity and use different equipment and supplies, it is important to learn how to design and equip parks and other recreation facilities so they serve youth of all ages.

Studies of Older Adults

Older adults are likely to use parks for physical activity,⁶⁵ but they also use sidewalks for walking and may rely on senior centers for activity programs. There are enough studies of recreation environments and physical activity in older adults to indicate this is a promising area. For example, Payne and colleagues reported older adults who visited local parks were more active and had better mental health than those who did not use parks.⁸⁷ Li and colleagues found proximity to parks, perceptions of safety, and number of nearby recreation facilities were related to walking in seniors.⁵⁸ They built on this study by following participants over one year to examine possible reasons for the commonly seen decline in physical activity. They found that over a 12-month period, walking decreased less in older adults who lived in neighborhoods with safe walking environments and access to recreation facilities.⁸⁸ Older adults may benefit from access to places where they can feel safe being active. Because easy access to shopping malls was associated with more walking, providing access to facilities that serve these same functions could be an effective intervention.⁸⁹ Research on built environments and physical activity among seniors is just beginning.

Disparities in Recreation Environments

It is not clear whether all sociodemographic groups benefit equally from having access to recreation facilities, because this question rarely has been examined. However, the findings appear contradictory. Reed and colleagues found presence of sidewalks was related to physical activity only in whites, not in African Americans.⁹⁰ In a study by Wilson et al. access to trails was related to physical activity in low socioeconomic status (SES) participants, but not among the high SES.⁹¹ Additional studies are needed to understand whether recreation facility/physical activity associations generalize across population subgroups.

There are physical activity disparities in youth, with lower income and racial/ethnic minority youth usually having lower activity levels, and a national study showed recreational environments may help explain the disparities.⁹² Thus, it is of great interest to determine whether there are disparities in access to recreation facilities which could affect physical activity of all age groups. In self-report studies, lower-income adults perceive less access to recreation facilities.^{91, 93} It is surprising that two studies reported high income participants had better access to free-for-use facilities such as public parks, but not pay-for-use facilities such as health clubs and dance studios.^{94, 95} In a large national study using GIS-based measures, Gordon-Larsen and colleagues found less access to both free and pay facilities in low-education and high-minority areas.⁹² Another national study replicated the finding of fewer private recreation facilities in low-income and high-minority communities.⁹⁶

The evidence indicates that low-income and racial/ethnic minority populations have less access to recreation facilities. Thus, recreation policies and investments need to ensure low-income communities have equal access to recreation facilities. Disadvantaged communities need better access to public parks and trails, because pay-for-use facilities are generally not available to them.

Importance of the Social Environment

Though this paper focuses on the built environment, an ecological perspective would indicate that built and social environments are likely to act together to influence physical activity. Of the many social environment issues that could be relevant to physical activity, built environment researchers have been most interested in safety. Perceived or objective danger from crime or traffic hazards could negate benefits of activity-friendly built environments if people are too afraid to walk on the streets, go to the park, or allow their children to play outdoors.

A 2002 review concluded the data on safety and physical

activity are inconsistent.⁶⁴ However, many of the measures of safety are crude, and many do not distinguish among safety related to crime or traffic. There are enough significant findings to justify further study of safety. Several recent studies of youth report significant associations of physical activity with crime safety^{86, 97-99, 100} or traffic safety,^{45, 101} though some do not support an association.^{83, 102, 103} Among adults, African Americans perceive their neighborhoods as less safe than whites,³⁵ so safety concerns could contribute to disparities in physical activity. A finding that safety was related to walking in whites but not in African Americans needs to be replicated.³⁴ In the adult literature, most recent studies show an association of crime and physical activity.^{36, 70, 71, 74} Because there are built environment strategies for reducing both the actual and perceived risk of crime, safety variables should continue to be included in built environment/physical activity studies.¹⁰⁴

Conclusions

Current evidence about the association of various built environment attributes with physical activity for recreation and transportation purposes is summarized in Table 1. Though not reviewed here, evidence is growing for associations between the built environment and obesity.¹⁰⁵ Community design and walkability attributes are related mainly to active transportation, although several studies have shown walkability also is related to total physical activity. Recreation environments mainly support leisure-time physical activity, and this specific effect is reflected in Table 1. Sidewalks are used frequently for both transportation-related and leisure-time physical activity, so they are one of the few variables found to be related to both types of outcomes. Crime, traffic safety and aesthetics have the potential to affect both domains of activity.

Adult populations have been studied most often and seniors least often. It is likely the built environment has different effects on men and women, high and low income communities, and people from diverse racial and ethnic backgrounds. Thus, the research needs to focus more on the needs and concerns of more diverse populations. Other research needs are to use more detailed measures of built environments so findings can provide specific guidance to policy makers and designers, use more rigorous approaches such as prospective and quasi-experimental designs, and understand how both community design and recreation environments contribute to total physical activity.

Knowledge about the built environment and physical activity is growing rapidly, and efforts already are being made to use research findings to guide policy changes. Working groups from the Transportation Research Board and Institute of Medicine²⁶ and Task Force for Community

Table 1.
Built environment associations with physical activity
for transportation and leisure purposes, summarized by
age group.

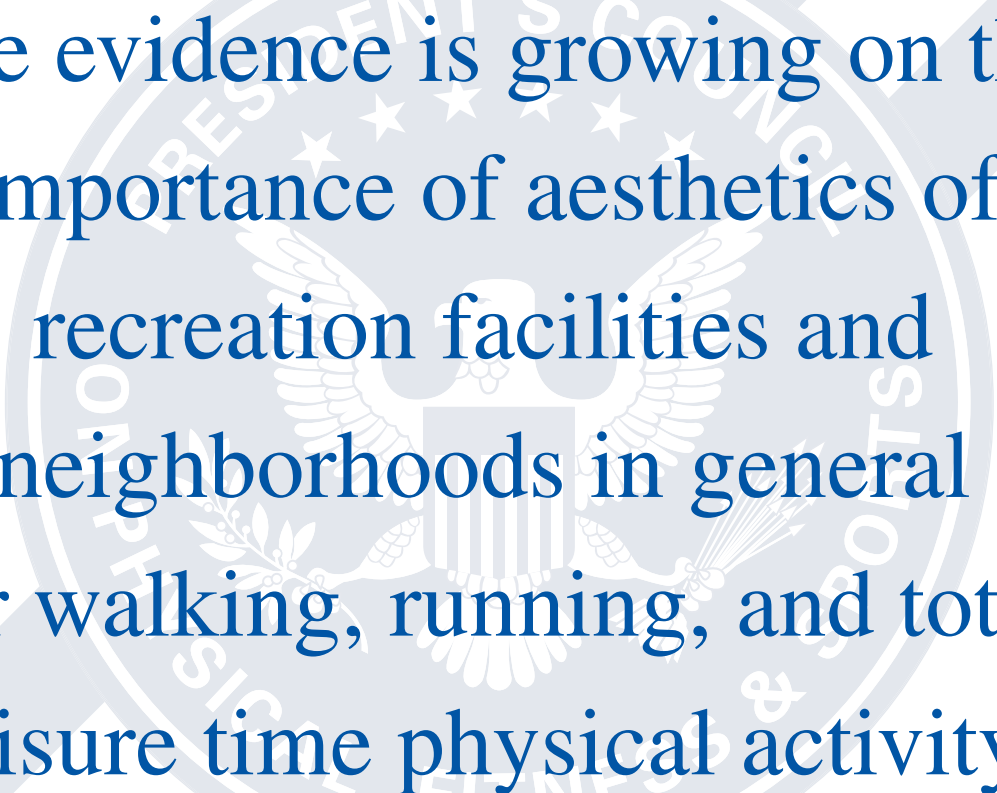
Built Environment Attribute	Active Transport	Active Recreation or Total Physical Activity
Findings for Adults		
Walkability: mixed land use, street connectivity, residential density	++	0
Sidewalks	?	+
Proximity of recreation facilities (parks, trails, private facilities)	0	++
Aesthetics of recreation facilities	xx	++
Studies of Youth		
Walkability: mixed land use, street connectivity, residential density	+	+
Street connectivity	?	?
Sidewalks	+	+
Proximity of recreation facilities (parks, trails, private facilities)	xx	++
Aesthetics of recreation facilities	xx	+
Studies of Older Adults		
Walkability: mixed land use, street connectivity, residential density	+	+
Sidewalks	xx	xx
Proximity of recreation facilities (parks, trails, private facilities)	xx	+
Aesthetics of recreation facilities	xx	xx

Notes: ++: multiple findings of positive association; +: a few findings of positive association; 0: a few findings of no association; ? inconsistent findings; xx: insufficient studies to summarize

Preventive Services²⁷ concluded the evidence is sufficient to recommend policy changes. The built environment is a direct reflection of policies, and creating more activity-friendly environments will involve collaboration among multiple government departments and sectors of society outside government. Government agencies dealing with zoning, planning, transportation, building codes, education, and recreation are directly responsible for the built environment variables described throughout this paper. Industries dealing with construction of buildings and roads, real estate, recreation, and health have important stakes in the built environment, so they need to be engaged in efforts to change policies. Because physical activity is a significant determinant of health and health care costs, there is a strong rationale for adopting and implementing policies to create built environments that make it convenient, safe, and attractive for people of all ages and circumstances to be physically active.

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The seal of the President's Council on Physical Fitness & Sports is centered in the background. It features an eagle with wings spread, perched on a shield with vertical stripes. The eagle is surrounded by a circular border containing the text "PRESIDENT'S COUNCIL ON PHYSICAL FITNESS & SPORTS".

The evidence is growing on the importance of aesthetics of recreation facilities and neighborhoods in general for walking, running, and total leisure time physical activity.

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