

HAPI

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Physical Activity, Health, and Place

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Photo by Ann Forsyth

The HEALTH AND PLACE INITIATIVE (HAPI) investigates how to create healthier cities in the future, with a specific emphasis on China. Bringing together experts from the Harvard Graduate School of Design (HGSD) and the Harvard School of Public Health (HSPH), it creates a forum for understanding the multiple issues that face cities in light of rapid urbanization and an aging population worldwide.

Health and Places Initiative
<http://research.gsd.harvard.edu/hapi/>
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The Research Briefs series summarizes recent research on links between human health and places at the neighborhood or district scale and provides background for a number of other forthcoming products—a set of health assessment tools, planning and urban design guidelines, urban design prototypes, and neighborhood cases. While the Research Briefs draw out implications for practice, it is these other tools that really provide specific, real-world guidance for how to create healthy places.

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Big Ideas

- Physical activity is a critical part of maintaining health and preventing disease.
- Individual factors (e.g. demographics, social factors, costs of alternative modes of transportation, car ownership, interest in outdoor recreation) are probably more important in predicting physical activity than a neighborhood's built environment. Self-selection—people who want to walk or cycle pick environments likely to support that—has likely led to overestimating the effect of neighborhoods on walking.
- However, there is evidence that the built environment has an influence on certain types of physical activity above and beyond individual factors—evidence is strongest for walking and cycling for transportation.
- Different built environment features (e.g. mixed land use, density) are correlated with transport physical activity versus recreational physical activity (e.g. parks, trails).
- Population density, connectivity (either streets or trails), and land use mixture are the most consistently related to walking and cycling for transport.
- Safety, neighborhood aesthetics and topography, and availability of physical activity equipment are related to walking for recreation/exercise.
- Different age groups and genders have different needs and preferences. For example, in some studies areas with high street connectivity and population density (e.g. marked with heavier traffic and more intersections) are correlated with transport physical activity for adults, but negatively associated with recreational physical activity in children. Older adults may face considerably more accessibility issues than younger adults, due to increasing disability. However, literature is limited on the needs and preferences of different groups.

What the Research Says

Health Issues

Physical activity can be defined as, “any bodily movement produced by skeletal muscles that requires energy expenditure” (WHO 2014). Physical activity is a well-known and critical factor for energy balance and weight control, reducing the risk of hypertension, heart disease, stroke, diabetes, some cancers and depression, and increasing longevity (WHO 2014). The World Health Organization (2014) recommends that adults aged 18–64 get 150 minutes of moderate intensity activity a week to prevent risks of chronic diseases.

Physical activity is often categorized in two ways: for transport or for recreation/exercise (McCormack and Shiell 2011). However, people may be physically active in other ways, for example at work or when doing household chores. This review focuses on physical activity for transportation and recreation as that is the part of physical activity that neighborhood or district environments are most likely to affect (whether that neighborhood is around the home, work, or school, or where people socialize or conduct other ordinary activities).

It is important to note that there are many determinants of physical activity besides just the built environment. For example, demographics and individual characteristics play a large role in physical activity, such as age, gender, ethnicity, income-level, car-ownership, motivation, or confidence (Abraham et al. 2010; Bauman et al. 2012; Casagrande et al. 2009). Other factors may include social support, cultural norms, and other larger national policy or global determinants (Bauman et al. 2012, 259).



Cultural norms and larger national policies influence physical activity rates. For example, the Netherlands is known for its cycling-friendly norms and culture.

Photo by Ann Forsyth

Place Issues

Many people have intuitions about environments that would support physical activity. What matters for this research brief is not, however, individual experiences, but rather the general balance of evidence.

Fortunately, this is an area where research has been growing rapidly. Unfortunately, much of it comes from only a few countries—the U.S. and Australia being prominent—though recently there has been more international work in a variety of environments. This brief takes advantage of this recent work in later sections.

Vulnerable Groups

In some countries **those with low-incomes and ethnic minorities** may be more affected by the residential neighborhood built environment's impact on physical activity, particularly recreational physical activity. However, low-income individuals are more likely to be physically active during work or a commute than for recreational exercise, and so the neighborhood recreational environment may be less important. These findings emphasize the importance of local context and individual or community factors.



Photo by Ann Forsyth

In some countries, those with low-incomes and ethnic minorities may be more affected by the residential neighborhood built environment's impact on physical activity, particularly recreational physical activity. On the other hand, low-income individuals are more likely to be physically active during work or a commute than for recreational exercise, and so the neighborhood recreational environment may be less important.

Example: Lovasi et al. (2009) reviewed 45 studies on built environments and obesity in disadvantaged populations in the United States. They found, “The importance of neighborhood exercise facilities for supporting physical activity has been documented, but not all studies have replicated this finding or demonstrated its relevance for weight change. Further, proximity to exercise facilities may not be sufficient to affect behavior for all populations, especially if additional barriers such as cost, restricted operating hours, or poor maintenance are present. Interestingly, locations commonly used for exercise differ by income level and gender, with low-income individuals more likely to use shopping malls and high-income individuals more likely to use tread-mills” (Lovasi et al. 2009, 13, citations removed).

Example: Bauman et al. (2011) compared socioeconomic differences in the prevalence of different types of physical activity across six Asia-Pacific countries (Australia, China, Fiji, Malaysia, Nauru, and the Philippines) using population-wide representative surveys. For urban residents of China (N=142,693), Fiji (N=6,763) and Malaysia (N=2,572), higher levels of education and income were related to greater amounts of leisure physical activity, but lower occupational or transportation related physical activity, compared to those from rural areas with lower education levels or lower incomes. Recreational physical activity increased with age in China, but showed inverse associations for Fiji and Nauru men. No other age effects were found for other countries.



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Things for Certain (or semi-Certain)

Recent systematic reviews paint a comprehensive picture of environmental supports for physical activity for transport or recreational/exercise (see Table 1). Supports for total physical activity (e.g. where these concepts are not distinguished) are less clear. NR=not reported; ++ significant positive association; 0, neutral or no significant association found; +0 = inconsistent/or weak positive (mix of significant and non-significant).

Table 1. Systematic Reviews of Built Environment Characteristics and Physical Activity¹: Summary of Results.

Study characteristics	Ding 2011	McCormack 2011	Rosso 2011	van Cauwenberg 2011	van Holle 2012	Wendel-Vos 2007
Ages	<18	18+	60+	Average age of sample 65+	18-65	18+
Publication period of studies included	1993-2009	1996-2010	1990-2010	2000-2010	2000-2011	1980-2004
Number of studies included	103	33	17	31	70	47
Report type	Review	Systematic review	Comprehensive review	Systematic review	Systematic review	Systematic review
Walking for Transportation						
Land-use mix/destinations	++	++	++	0	+0	0
Residential density	+0	++	+0	0	+0	NR
Street connectivity	+0	++	++	+0	0	NR
Walkability ²	++	++	+0	0	+0	NR
Transit proximity/access	NR	+0	0	0	0	0
Recreation or Leisure Physical Activity (mainly walking, but also cycling or other)						
Parks (access/density/proximity)	+0	0	NR	0	NR	NR
Recreation facilities (access/density/proximity)	+0	+0	++	+0	0	+0
Low traffic speed/volume	+0	0	0	0	+0	0
Both Transportation and Leisure Physical Activity/ Total Physical Activity						
Walking/biking facilities (e.g. sidewalks, bike paths, trail connectivity)	+0	+0	++	0	+0	+0
Pedestrian safety structures (e.g. crosswalks, traffic lights)	++	NR	NR	+0	+0	0
Safety (from neighborhood disorder or crime)	+0	NR	NR	+0	0	0
Aesthetics (variety/diversity/vegetation)	+0	0	NR	0	0	+0

Adapted from Bauman (2012), Ding et al. (2011) and McCormack (2011)

- Physical activity in most studies refer to walking, however, cycling and other recreation (jogging, etc.) were included in some.
- Walkability is a composite score, such as the Neighborhood Environment Walkability Scale (NEWS). Walkability scores include features such as residential and commercial density, land use mix, street connectivity, access to recreational facilities and transportation, safety (traffic/crime) and aesthetic elements.

Physical Activity for Transportation

In terms of physical activity for transport (e.g. mainly walking, but also cycling): walkability (see footnote 2), street connectivity, and land use mixture (e.g. shopping/work close to housing) seem to be among the most consistent and influential.

Recreational Physical Activity

Other forms of physical activity (e.g. mainly recreation walking, but also recreational cycling, jogging, etc.) are less consistently tied to built environments. Rather, other factors from cost to personal preferences are more important.

Access to recreational facilities has been weakly related to recreational physical activity in three systematic reviews, and more strongly in two reviews. One systematic review did not find a connection between access to recreational facilities and recreational physical activity. Access to recreational facilities may be more important for children (Ding et al. 2011) or older adults (Rosso et al. 2011, van Cauwenberg 2011), but more mixed for adults (McCormack 2011, van Holle 2012, Wendel-Vos 2007).

General or Total Physical Activity

Pedestrian facilities, such as sidewalks, are weakly related to physical activity in two systematic reviews, and strongly related in one systematic review.



Photo by Ann Forsyth

In terms of physical activity for transport walkability, street connectivity, and land use mixture seem to be among the most influential factors.

Things up in the Air

The evidence for how the built environment affects physical activity for recreation/exercise is not as clear compared to transportation, and many features relate to such items as exercise equipment, as opposed to the more general “recreational facilities” (e.g. parks, playgrounds, beaches, community centers).

Example: In a systematic review of 47 articles, Wendel-Vos et al. (2007, 425) found, “Availability of physical activity equipment was convincingly associated with vigorous physical activity/sports and connectivity of trails with active commuting. Other possible but less consistent correlates of physical activity were availability, accessibility and convenience of recreational facilities.”

There is growing evidence that urban sprawl may not impact obesity for disadvantaged groups, as opposed to other factors like the food environment, places to exercise, or neighborhood safety (Lovasi et al. 2009, 15; McCormick and Shiell 2011, 8).

Example: Lovasi et al. 2009 reviewed 45 studies on built environments and obesity in disadvantaged populations in the United States. The studies showed mostly mixed or no connection between a sprawling



Photo by Ann Forsyth

Recreational physical activity seems to be less tied to the built environment. Rather, other factors from cost to personal preferences are more important.

environment (low walkability, car-oriented) and target groups being adversely exposed and affected. They conclude, “We can reject low walkability or sprawling urban form as a candidate explanation of obesity-related health disparities; these measures seemed relatively less correlated with physical activity and obesity for individuals within our target groups, while at the same time the target groups were not at a disadvantage with regard to the walkability as commonly measured” (Lovasi et al. 2009, 15). Rather, “Upon consideration of the obesity and behavioral correlates of built environment characteristics, research provided the strongest support for food stores (supermarkets instead of smaller grocery/convenience stores), places to exercise, and safety as potentially influential for disadvantaged groups” (Lovasi et al. 2009, 7).

There is inconclusive evidence as to whether increasing physical activity for transportation increases overall levels of physical activity, although it likely does some. The link to obesity is not as clear.

Example: In a systematic review and carefully curated selection of 46 articles, Wanner et al. (2012) conclude, “There is limited evidence that active transport is associated with more physical activity as well as lower body weight in adults” (Wanner et al. 2012, 493).

Example: Yang et al. (2010) conclude, “On the basis of current evidence, the relation between changes in cycling behaviour and changes in overall physical activity directly attributable to interventions is unclear” (Yang et al. 2010, 7).

Example: Faulkner et al. (2009) conducted a systematic review (13 studies) on active school transport (AST), physical activity, and body weight of children and youth. The review concludes, “These studies demonstrate that active school commuters tend to be more physically active overall than passive commuters. However, evidence for the impact of AST in promoting body weights for children and youth is not compelling” (Faulkner et al. 2009, 3).

While there is growing evidence that environmental factors may promote (or inhibit) physical activity, research in this area is still very limited and inconsistent

in evaluating confounding variables. Additionally, the research has almost exclusively focused on high-income developed countries: United States, Australia, and Western Europe.

Example: Wanner et al.’s (2012) systematic review of active transportation and physical activity discusses how, “All but one of the studies were cross-sectional. Therefore, it is not possible to infer causality and the direction of the association: Does active transport contribute to higher amounts of physical activity (causality), or are physically active individuals more likely to use active transport (reverse causality)? Does active transport contribute to a lower BMI because of higher energy expenditure (causality), or are lean individuals more likely to walk or cycle for transport purposes than overweight individuals (reverse causality)? Both directions seem plausible. Physical activity is associated with higher energy expenditure, and severe obesity may limit physical activities” (Wanner et al. 2012, 499).

Implications

In these HAPI Research Briefs we aimed to find implications for planning and design at roughly the neighborhood level. These could include quantifiable standards, more qualitative but yet evidence-supported insights, and other good practices that may help and that are generally good things to do. Not every topic has a full complement of these implications.

Standards and Insights

The built environment is a small part of the picture in terms of why people are physically active—other factors from personal history and social support to pricing of options likely loom larger. Also different forms of physical activity and types of people are supported by different kinds of environments. So the key insight is to provide options for different forms of physical activity.

Table 2 evaluates the usefulness of neighborhood characteristics promoting physical activity among different age groups. It is based both on systematic and more general reviews of the evidence.

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Table 2. Strength of evidence (usefulness) of key options by age to promote physical activity in the built environment.

Neighborhood Characteristics	Children (<18)	Adults (18-65)	Older Adults (65+)
Transportation PA			
Land-use mix/destinations	3	4	5
Residential density	6	7	
Street connectivity		8	9
Walkability	10	11	12
Transit proximity/access			
Recreation or Leisure PA			
Parks (access/density/proximity)	13	14	15
Recreation facilities (access/density/proximity)	16	17	18
Low traffic speed/volume	19	20	21
Both Transportation and Leisure/ Total PA			
Walking/biking facilities (e.g. sidewalks, bike paths)	22	23	
Pedestrian safety structures (e.g. crosswalks, traffic lights)	24	25	
Safety (from neighborhood disorder or crime)	26	27	28
Aesthetics (greenness/rated attractiveness)	29	30	

LEGEND: Strength of evidence High Medium Low

- 3. Ding et al. 2011; Fraser et al. 2010
- 4. Durand et al. 2011; Ewing and Cervero 2010; Fraser et al. 2010; Frost et al. 2010; Krizek et al. 2009; McCormack et al. 2011; Saelens et al. 2003; Sugiyama et al. 2012; van Holle et al. 2012
- 5. Rosso et al. 2011 (mixed)
- 6. de Vries et al. 2007; Ding et al. 2011; Dunton et al. 2009; Fraser et al. 2010
- 7. Durand et al. 2011; Krizek et al. 2009; McCormack et al. 2011; Saelens et al. 2003
- 8. Bauman et al. 2012; Ewing and Cervero 2010; Krizek et al. 2009; McCormack et al. 2011; Saelens et al. 2003; Sugiyama et al. 2012
- 9. Rosso et al. 2011 (mixed)
- 10. Ding et al. 2011
- 11. Bauman et al. 2012; Frost et al. 2010; van Holle et al. 2012
- 12. Rosso et al. 2011; van Cauwenberg 2011 (mixed)
- 13. de Vries et al. 2007
- 14. Durand et al. 2011; Fraser et al. 2010; Frost et al. 2010
- 15. Rosso et al. 2011 (mixed)
- 16. de Vries et al. 2007; Ding et al. 2011; Dunton et al. 2009; Gomez et al. 2004
- 17. Bauman et al. 2012; Sugiyama et al. 2012; Wendel-Vos 2007
- 18. Rosso et al. 2011; van Cauwenberg 2011 (mixed)
- 19. de Vries et al. 2007; Ding et al. 2011; Fraser et al. 2010
- 20. Casagrande et al. 2009; Fraser et al. 2010
- 21. Rosso et al. 2011
- 22. de Vries et al. 2007
- 23. Casagrande et al. 2009; Fraser et al. 2010; Sugiyama et al. 2012; van Holle et al. 2012 (mixed); Wendel-Vos 2007
- 24. de Vries et al. 2007; Fraser et al. 2010
- 25. Bauman et al. 2012
- 26. de Vries et al. 2007; Fraser et al. 2010; Gomez et al. 2004
- 27. Casagrande et al. 2009; Frost et al. 2010
- 28. van Cauwenberg et al. 2011 (mixed)
- 29. Fraser et al. 2010
- 30. Bauman et al. 2012; Frost et al. 2010; Sugiyama et al. 2012

Table 3. Summary matrix showing the potential of different interventions to increase walking or cycling

Strategy	Increasing Walking	Increasing Cycling
Community design		
Infrastructure availability	Medium for adults; High for children	
Infrastructure of high quality (e.g. wide, tree-lined sidewalks throughout)		
Programs (campaigns, education, and marketing)	Insufficient robust evaluations	Insufficient robust evaluations
Pricing and convenience		
Combined strategies		

LEGEND: Strength of evidence

High	Medium	Low
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Source: Adapted from Forsyth and Krizek (2010) and Krizek et al. (2009), used with permission.

Cycling behavior can be promoted through both “hard” (e.g. infrastructure) and “soft” (e.g. policies, education) interventions.

Example: Fraser et al.’s (2010) systematic review of the environment and cycling (21 included studies) found, “The environmental factors identified as being positively associated with cycling included presence of dedicated cycle routes or paths, separation of cycling from other traffic, high population density, short trip distance, proximity of a cycle path or green space and for children projects promoting ‘safe routes to school’. Negative environmental factors were perceived and objective traffic danger, long trip distance, steep inclines and distance from cycle paths” (Fraser, Simon and Lock 2010, 738).

Example: In an international literature review of over 300 articles, Krizek et al. (2009, 5) concludes, “The most compelling argument, particularly for cycling, is that only via an integrated range of environmental features (including infrastructure and facility improvements), pricing policies, or education programs will substantive changes result.”

Example: Yang et al. (2010) conducted a carefully selected systematic review of 25 articles on interventions to promote cycling. Yang et al. (2010) conclude, “Evidence from observational studies suggests that changing the built environment has

the potential to influence cycling behaviour, but few data from controlled intervention studies are currently available to confirm this. Our review shows that it is unclear whether increases in cycling could be achieved at lower cost by addressing attitudes and perceptions about cycling” (Yang et al. 2010, 8). Therefore, “A strategy of changes to the environment combined with advice and support at both individual and institutional levels may, therefore, be required to bring about substantial and sustained changes in travel behaviour in the population” (Yang et al. 2010, 8).

See also Pucher 2010.

Comprehensive interventions to increase physical activity are best, meaning those that address people, policies and place in a comprehensive way, not just places alone.

Example: Sallis et al.’s (2012) literature review describes, “Ecological models specify multiple levels of influence on behavior, from individual and social factors to institutional, community, built environment, and policy factors. A key principle is that interventions should be most effective when they change the person, the social environment, and built environments and policies” (Sallis et al. 2012, 729).

Example: Heath et al.'s (2012) systematic review of literature reviews (n=100 reviews) evaluated the usefulness of recent (2000–2011) evidence-based interventions in physical activity. They found, “The informational approaches of community-wide and mass media campaigns, and short physical activity messages targeting key community sites are recommended. Behavioural and social approaches are effective, introducing social support for physical activity within communities and worksites, and school-based strategies that encompass physical education, classroom activities, after-school sports, and active transport. Recommended environmental and policy approaches include creation and improvement of access to places for physical activity with informational outreach activities, community-scale and street-scale urban design and land use, active transport policy and practices, and community-wide policies and planning. Thus, many approaches lead to acceptable increases in physical activity among people of various ages, and from different social groups, countries, and communities” (Heath et al. 2012, 272).



Photo by Ann Forsyth

Low volume traffic, recreational facilities, density, and safety from traffic and crime are important to encouraging physical activity for children.



Photo by Ann Forsyth

Interventions for older adults are less effective and consistent. However, there seems to be a connection between parks, recreational facilities, lower traffic volume, and recreational physical activity in this population.

Other Good Practices

While pedestrian amenities and aesthetics create an enjoyable and pleasing environment, the weight of the evidence suggests they are not ultimately strongly related to physical activity. However, some of these amenities have other important health promoting features.

Example: McCormack and Shiell's (2011, 6) systematic review found, “Based on the few studies reviewed there appears to be limited evidence for aesthetics supporting physical activity.”

Example: “Other than well-known attributes of walkable neighborhood (mixed and dense land uses), examples of urban design features that provide a pleasant and encouraging environment for cyclists and pedestrians and enhance health benefits include: (i) tree canopies, (ii) bike and pedestrian networks separated from traffic, (iii) public amenities (benches and public spaces), and (iv) green space. Such solutions respectively provide the added benefits of (i) cooling the air and protecting active travelers from heat; (ii) minimizing exposure to traffic air pollution, noise and crash hazards; (iii) encouraging social interaction; and (iv) improving mental health and well-being” (de Nazelle et al. 2011, 775).



Photo by Ann Forsyth

The most useful and best demonstrated connection is for walking for transportation among adults. There is a strong relationship between land use mix, density, connectivity, walkability, and walking for transportation.

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