A National Plan for Physical Activity: The Enabling Role of the Built Environment

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Background: Evidence shows significant relationships between aspects of the built environment and physical activity. Land use and transportation investments are needed to create environments that support and promote physical activity. Methods: The policy relevance of recent evidence on the built environment and physical activity is discussed, along with an assessment of near, medium, and longer term pricing and regulatory actions that could be considered to promote physical activity. These actions are evaluated based on their consistency with the current evidence on what would support and promote physical activity. Results: A wide range of pricing and regulatory strategies are presented that would promote physical activity. There is an unmet demand for activity friendly, walkable environments. Creating more walkable places is an essential component of a national plan to increase physical activity levels of Americans. Conclusions: The built environment is an enabler or disabler of physical activity. Creating more walkable environments is an essential step in averting what is currently a market failure where the supply and demand for walkable environments is misaligned. The desire to be more physically active would be supported through investments in walking, biking, and transit. Concentration of development within existing urban areas supported by transit and implementing pricing strategies can support physical activity.

Keywords: urban form, transportation, policy strategies

Despite the tremendous benefits of regular physical activity and numerous efforts to promote it, only about half of US adults get the recommended 150 minutes or more of moderate or vigorous physical activity a week.\(^1\)\(^2\) One study found that when objective physical activity measurement was used, fewer than 5% of adults met physical activity guidelines.\(^3\) Transportation systems and land use patterns (referred to in this paper as the built environment) are associated with travel patterns,\(^4\)\(^5\)\(^6\)\(^7\)\(^8\) and can therefore support or undermine physical activity. A growing body of literature supports this assertion.\(^10\)\(^11\)\(^12\) Other research has found correlations between the built environment and obesity\(^13\)\(^14\) and other chronic / noncommunicable diseases\(^15\) as well.

The summary built environment recommendations developed as part of the National Physical Activity Plan recommend a performance-based transportation funding process, where regions that make progress toward more active communities are rewarded. Two primary goals will provide the most direct assessment of whether this progress is being made: 1) increase the amount of active travel (transit, walking and bicycling), and 2) decrease the amount of sedentary travel (driving). There is substantial overlap between these 2 goals in terms of research and policy since decreases in driving will likely be supplanted by increases in transit, walking and bicycling, although the extent to which this substitution occurs is undermined.\(^16\)\(^17\)\(^18\)\(^19\)\(^20\)

Both goals have been repeatedly linked to health outcomes. Researchers have associated driving with an increased likelihood of obesity\(^21\)\(^22\)\(^23\) and lower physical activity levels.\(^24\) Not only is driving a sedentary activity, but when individuals spend long stretches of time in a car, it takes away time that might be spent on other things, such as physical activity. In 2001, the average American spent 64 minutes daily in a vehicle.\(^25\) Conversely, time spent on active transportation is a health benefit, and may reduce the amount of sedentary car time. Walking\(^21\)\(^22\)\(^24\)\(^26\)\(^27\) bicycling\(^22\)\(^24\)\(^26\)\(^27\) and public transport\(^22\)\(^27\)\(^28\) have all been linked to lower obesity levels and more physical activity. Walking requires little in the way of special equipment or training, is low-cost, and utilitarian walking and cycling can more easily be built into one’s daily routine. An Australian survey of nearly 2000 adults found that the streets were the most common place for physical activity, used by about 45% of respondents.\(^29\) A subsequent analysis on the same population
by the same authors30 affirmed the popularity of walking as a form of physical activity. Although few accumulated sufficient walking to meet physical activity guidelines, nearly three-quarters of the study population walked for transportation and nearly 70% walked for recreation. A UK study concluded that “Regular walking and cycling are the only realistic way that the population as a whole can get the daily half hour of moderate exercise which is the minimum level needed to keep reasonably fit”31.

These 2 goals are broadly applicable—many urban regions already use household travel surveys to collect data on travel patterns. Although travel surveys are typically less effective at capturing bicycle and pedestrian trips,32 they can provide some idea of trends over time and relatively accurate assessments of travel by vehicle and transit. As for the specific metric to use, daily or weekly minutes of bicycling and walking have the strongest connection to the published evidence and the federal government’s physical activity recommendations. Number of trips, miles and share of each mode relative to the others are also appropriate metrics to use if time data are not available, and each will tell a slightly different story about active transportation.

Objectives for Active Communities

Based on the published evidence from the public health and urban planning domains, it is also possible to articulate a number of policy objectives that will enable communities to meet the above goals. Urban planners will likely be familiar with these principles. Many urban regions have embraced them as a way to revitalize older urban cores, preserve undeveloped land, reduce air pollution and greenhouse gases, and diversify the transportation system. Physical activity represents yet another converging benefit of walkable, transit-oriented community design.

The 3 Ds: Density, Diversity, and Design. In a 1997 article Cervero and Kockelman33 used the term ‘3Ds’ to refer to the primary built environment concepts that influence transportation. We use this term to frame the discussion that follows. Density is the most common measure of walkability—compact neighborhoods bring homes in closer proximity to common destinations. Multiple studies have found that as the residential,4,18,34–36 retail38 and employment36 density of an area increases, so does walking and transit use, while auto use declines.

Diversity, or mix of land uses within an area, works in tandem with density to increase the number of destinations in close proximity to housing. Measures of land use diversity or the presence of shops and services close to home has been found to be negatively associated with the per capita amount of car travel33,36,37 and positively associated with active transportation36–40 physical activity41 and BMI.21

The third D—Design—has several components, and influences both actual and perceived convenience, safety and security in a neighborhood. Street network design—whether a street network is interconnected, as with a grid system, or dominated by dead-end streets and culs-de-sac—has been repeatedly associated with travel behavior. Interconnected street networks provide more route choices and more direct connections to destinations, and have been associated with more walking18,34,42 and less driving.33,44 The design of the street itself can also support physical activity—streets that are narrower, with sidewalks, street trees, lighting and other amenities can slow traffic and help to provide a safe, comfortable environment for walking. This aspect of the built environment is particularly difficult to measure, with little consistency in the research as far as what particular design aspects matter the most, and how to measure them.10 However if it is defined or measured, researchers have consistently found positive relationships between attractive street and neighborhood design and walking.18,29,30,45 Supportive street design has also been associated with fewer pedestrian injuries.46–50 A recent 11-country study found that sidewalks had the strongest associations with physical activity, out of a number of environmental variables.45 Other studies support the significance of sidewalks as a contributor to physical activity.29,41,51,52

Lastly, site design refers to the placement of the buildings on the site. Buildings that are situated on the back of the site, in the midst of a sea of parking, can add distance to a walking trip and generally create monotonous walking environments. Pedestrian-oriented site design, where buildings and their entryways are built close to the sidewalk, are more convenient and interesting, reducing the perceived walking distance. Site design is, as with other aesthetic variables, difficult to measure, and only a few studies appear to have done so. Some researchers have used building age as a proxy for pedestrian-oriented site design; Berrigan and Troiano53 found that people living in homes built before 1946 walked 46% more than those in homes built after 1974. PBQD54 found similar relationships—neighborhoods dominated by pre-WWII buildings generated significantly fewer vehicle miles traveled. Frank et al55 used retail Floor Area Ratio (FAR, a standard planning measure that relates the area of the building to the area of the site), in a walkability index that was found to predict active transport and vehicle miles of travel. The same measure was found in a subsequent study to positively influence walking, cycling and transit mode choice.43 Sidewalk coverage, site design and the pedestrian environment were all also associated with active travel to school in a US EPA study.55

Destinations. In planning practice, a 4th “D” has been informally added to the original three. The distance between major population and employment centers will determine the sheer distances people will be traveling for work, school and entertainment, with compact regions generating more opportunities for active transportation. How much a region “sprawls” has been positively associated with vehicle travel.4,56,57
Access to Parks, Open Space, and Recreational Facilities. Nearby access to parks, open space, and recreational facilities has been consistently associated with increased physical activity and walking. A number of studies have combined several of the above variables into indices. Although an index is not able to tease out the individual impacts of each variable, it is better able to account for covariance between variables, which often complicates research in this field. An index can also capture the synergistic effects that accrue when the variables occur together. In studies in the Seattle and Atlanta regions, Frank et al. found a ‘walkability index’ including residential density, land use mix and street connectivity to be a significant predictor of several transportation and health-related outcomes. Ewing et al. tested the ability of a county-level ‘sprawl index’ made up of similar density, mix and connectivity components to predict health outcomes at the national level, and found it to be significantly related to Body Mass Index (BMI), obesity and hypertension. Another study using the same index found a relationship to the number of chronic health conditions and overall physical health-related quality of life. A simpler ‘sprawl index’ developed by Lopez made up of regional population density was found to be a predictor of overweight and obesity, lending credence to the theory that density may function as a reasonable proxy for other, more difficult to measure urban design characteristics at the metropolitan level. One study comparing residents living attractive, walkable (compact, mixed and connected) neighborhoods to those in less walkable neighborhoods found those in the walkable neighborhood got 70 more minutes of physical activity, and had lower obesity rates. A recent 11-country study found that neighborhoods with 6 out of 6 activity-supportive variables present (shops and transit stops near home, presence of sidewalks and bicycle facilities, low-cost recreational facilities, and fewer single-family homes) had physical activity levels that were 100% higher than those with no supportive characteristics present. Although the environmental variables were associated with higher physical activity on their own, results suggest that having a critical mass of characteristics will contribute to more dramatic gains in physical activity.

Vulnerable Populations. Lastly, policymakers should seek to improve facilities and provide better access for sociodemographic groups that may realize disproportionate benefits from active communities. An auto-oriented transportation network where using transit, walking or bicycling is unsafe or difficult marginalizes that those who cannot or do not drive—youth under 16, disabled persons, the elderly, and low-income households—exacerbating the difficulties many of these groups already have with staying active and healthy. Our land use patterns and transportation investments should allow people of all ages and abilities to maintain a basic level of independence, mobility and physical activity. In addition, the evidence supports that gender, ethnic-ity, age, and socioeconomic status will all influence the group of factors that play into an individual’s decision to use transportation or to be physically active. King asserts that the evidence points to “substantial overlap” between variables impacting particular population subgroups and “those believed to influence physical activity throughout the population as a whole.” Although more recent research has added detail and depth to the little we know about how the built environment influences different populations, we should not lose sight of the fact that the whole population can benefit from interventions that make it easier to be physically active as part of everyday life.

Actions, Synergies, and Opportunities

Much of the recent discussion about the built environment and health has revolved around the coming reauthorization of the federal transportation bill, which will probably continue into the next year. A convergence of urgent issues that all “touch” transportation—climate change, public health and safety, the dwindling of the Highway Aid Trust Fund, unstable oil prices, and an aging network of roads, bridges and rail infrastructure—add up to the need for wholesale transportation reform at the federal level. Beyond Washington D.C., states, regions and local governments can take a number of actions to support physical activity through the built environment and transportation. There are nearly countless opportunities to implement the principles discussed above, which in many cases can be implemented regardless of what happens at the federal level. Table 1 provides a listing of the short, medium, and long range actions that can be taken to promote physical activity.

Short Term Actions. Many programmatic strategies, simple legislation or changes in transportation pricing structures can be implemented fairly quickly (under 5 years, sometimes less), often in partnership with the private sector. Pricing and programs can work on their own, especially for people that need just a small ‘push’ to switch modes. However, infrastructure, services and land use patterns that support transit, walking and cycling will increase the impact of these actions. This is especially important in the case of disincentives and pricing, which may be perceived as heavily punitive, particularly if alternatives to driving are limited. Targeted increases in transit service or investments in bicycle and pedestrian infrastructure can be geographically targeted to complement programmatic actions to promote physical activity and reduce auto dependence.

Trip reduction or transportation demand management (TDM) programs for employers offer incentives for employees using non-drive-alone travel modes that can range from free transit passes to extra vacation time, amenities for active commuters such as showers, lockers and bicycle parking, and parking “cash-out,” where employees who do not use their parking spot can receive the cash equivalent in their paycheck. Trip reduction...
Table 1  Built Environment Actions to Promote Physical Activity

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<th>Short-term actions</th>
<th>Geographic applications</th>
<th>Synergies with other strategies</th>
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<tr>
<td>Trip reduction / transportation demand management programs</td>
<td>District/neighborhood region/state</td>
<td>Transit service increases, PAYD insurance, bicycle / pedestrian infrastructure investment, parking pricing, road pricing</td>
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<tr>
<td>Safe routes to schools programs</td>
<td>School district city/town</td>
<td>Bicycle / pedestrian infrastructure investment, school siting / redevelopment</td>
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<tr>
<td>Complete streets legislation</td>
<td>City/town state</td>
<td>Supportive zoning / development regulations, bicycle / pedestrian infrastructure investment, spot redevelopment, street connectivity</td>
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<tr>
<td>Parking pricing</td>
<td>District/neighborhood city/town region</td>
<td>Transit service increases, HCT investment, bicycle / pedestrian infrastructure investment</td>
</tr>
<tr>
<td>Pay-as-you-drive insurance</td>
<td>State</td>
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<tr>
<td>Location-efficient mortgages</td>
<td>City/town region</td>
<td>Supportive zoning / development regulations, spot redevelopment, transit service increases, HCT investment, bicycle / pedestrian infrastructure investment</td>
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<tr>
<td>Transit service increases</td>
<td>District/neighborhood city/town region</td>
<td>Trip reduction programs, parking pricing, supportive zoning / development regulations, spot redevelopment, road pricing, GM legislation</td>
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<tr>
<td>Medium range actions</td>
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<tr>
<td>Supportive zoning / development regulations</td>
<td>District/neighborhood city/town</td>
<td>Transit service increases, HCT investment, spot redevelopment, street network changes, bicycle / pedestrian infrastructure investment</td>
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<tr>
<td>“Spot” redevelopment (such as transit-oriented development, grayfield or brownfield redevelopment)</td>
<td>District/neighborhood</td>
<td>Transit service increases, HCT investment, supportive zoning / development regulations, street network connectivity, bicycle / pedestrian infrastructure investment</td>
</tr>
<tr>
<td>Parks / open space investment</td>
<td>District/neighborhood city/town region</td>
<td>Bicycle / pedestrian infrastructure investment, school siting / redevelopment, GM legislation</td>
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<td>Bicycle / pedestrian infrastructure investment</td>
<td>District/neighborhood city/town region state</td>
<td>Parks / open space investment, transit service increases, HCT investment, SR2S programs, Complete Streets legislation, parking pricing, road pricing, street network connectivity</td>
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<tr>
<td>High capacity transit investment</td>
<td>City/town region</td>
<td>Trip reduction programs, parking pricing, supportive zoning / development regulations, spot redevelopment, bicycle / pedestrian infrastructure investment</td>
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<tr>
<td>Road pricing</td>
<td>City/town region</td>
<td>Trip reduction programs, transit service increases, PAYD insurance, HCT investment, bicycle / pedestrian infrastructure investment</td>
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continued
programs can also be repositioned as health and wellness programs to encourage active commuting. Safe Routes to Schools programs likewise use a combination of programs, education and infrastructure investment to get youth walking and cycling to school. ‘Complete Streets’ legislation requires the accommodation of all modes of transportation during construction, and in some cases, repaving.

Many short-term actions involve financial incentives and/or disincentives. Parking pricing is discussed in-depth elsewhere. Distance-based or ‘Pay as You Drive’ (PAYD) vehicle insurance changes the insurance structure so that the user pays a higher per-mile rate. Currently, auto insurance premiums vary only a small amount based on mileage, even though accident rates are closely tied to mileage. Changing this structure to one that varies more by distance gives auto owners an incentive to reduce the amount of driving that they do and to find other active means of transport. Using current price elasticities, Litman estimates that PAYD insurance could reduce vehicle miles traveled by 10 to 12%, reducing traffic crashes and amount driven. Currently, insurance companies in the US and abroad are piloting the concept. Another important mechanism to promote physical activity is Location-Efficient Mortgages (LEMs). LEMs increase the buying power for people that purchase homes in urban areas with good transit service. LEMs assume that these households will be able to do more of their travel by transit, bicycling or walking, and will therefore be able to save money by driving less or even being able to get rid of a car. LEMs are based on the evidence that people who live in more walkable, transit-supportive environments spend less on transportation and can therefore service a higher mortgage debt. As basic concept, LEMS are very important because they provide a direct incentive to move to a more walkable environment where physical activity from transportation is a part of daily life.

**Medium Range Actions.** These actions will require larger scale changes to existing regulations or legislation, and possibly time to build up political support or study the issue. It may be necessary to implement some as part of a larger planning process. These changes can take 5 to 15 years to implement or even more, depending heavily on market conditions and political support.

Changing land use patterns is typically viewed as a long range strategy, but in targeted areas it is possible to achieve more substantial results in a shorter time frame. Piloting changes to zoning and development regulations in small areas can also be a good way to build political support before applying those changes at a broader scale. When carefully implemented, places like transit stations, brownfields (industrial areas) and greyfields (vacant shopping centers) excel as a way to demonstrate the value of compact, walkable, transit-oriented development to the general public. Situating affordable housing near transit will have a great deal of value and can be done through requirements or incentives for developers, such as expedited permitting and density bonuses.

Other medium range actions include larger-scale public investments such as parks and open space, bicycle and pedestrian infrastructure, and high-capacity transit. Although incremental implementation is possible, a plan and a funding source will be necessary before major change can be realized. In some cases, funding can be generated through public-private mechanisms such as Local Improvement Districts or Tax Increment Financing.

Lastly, road or congestion pricing can be used to achieve objectives of reducing driving, generating revenue, or managing congestion. Road pricing is generally controversial and will take awhile to build political support, especially for ‘cordon’ schemes such as London’s that charge a fee to drive into the city center. Implementation in the U.S. has so far been limited to single corridors and High-Occupancy-Toll (HOT) lanes.
in a few urban areas; 5 more (San Francisco, Seattle, Chicago, Minneapolis, and Miami) were recently selected to implement road pricing as part of a federal pilot program.

Long Range Actions. These actions can take decades, and often longer, to be implemented and fully take effect. They will, however, provide some of the most enduring and effective changes in built form and most strongly support the environment and a region’s economic well-being, in addition to supporting individual physical health. Nor should the long range nature of these actions deter planners and public health officials from taking the necessary steps toward their implementation now. Demographic and economic trends are converging to support a major turnover in the built environment by 2025,77 creating a poignant opportunity to create active communities. Investment in high-capacity transit or other major changes to transit infrastructure is one of the most important long range actions, as is growth management legislation (such as urban growth boundaries or concurrency ordinances). To be most effective, these strategies should be implemented at the regional level, and interjurisdictional coordination will add time to the process. Generating the necessary political support may also be an issue.

The redevelopment of schools to better support active transportation is another long-term issue. Schools should be located in more central and walkable areas, and the redevelopment of existing urban schools over new construction in outlying areas should be encouraged. Recent evidence (and logic) make it clear that distance between home and school is an overriding critical factor in determining if kids can and will walk to school.78–80 Neighborhood design features where kids live and go to school, and the characteristics of the routes between the two, can promote active travel. However, this is only the case when distances between home and school are less than about a mile—and even less for younger kids. Currently, standards and practices favor the opposite—since World War II school size has quintupled, while the number of schools declined by 70%—reflecting a preference for more parking, more sports fields, and cheaper suburban sites. Funding policy also frequently favors new construction over renovation.55

Since school boards represent a completely different set of actors and interests, the time needed for education, debate and eventual change may be substantial.

In already built-up suburban areas that are dominated by wide arterials, winding local streets, and culs-de-sac, street connectivity will be one of the slowest aspects of the built environment to change. Local planners can help to increase connectivity incrementally by identifying future street connections as part of local plans so that when parcels are developed those connections can be created. In some suburban areas, creating pathways between culs-de-sac may be appropriate, especially if right of way exists. Community acceptance and personal security may be an issue. However, it is also possible to provide incentives for communities to be more welcoming to pedestrian connections to nearby commercial destinations. For example, these connections could come with recreational amenities within these communities. They could also include vegetation and design treatments that increase the quality of the environment and land values as a result.

Future Needs for Research and Practice

There is very limited causal evidence linking the built environment to physical activity, although the current body of evidence consistently finds correlation. This point has often been made, and its implications debated, in the literature. It is possible that land use patterns may be merely masking the effect of underlying preferences for neighborhood type and/or travel choice.30 For example, people that prefer driving to walking will ‘self-select’ into neighborhoods where it is easier to drive. A growing number of researchers have been testing the relationships between the built environment and travel / health related outcomes, while taking into account people’s preferences for neighborhood type and/or travel mode. The results suggest that both preferences and the built environment impact our travel behavior.42,81–86

Although randomized clinical trials are not particularly feasible for research on the built environment, future research funding should be directed to longitudinal analyses and other designs that are better able to capture the impact of the built environment over time, thereby better addressing issues of causation. These opportunities are often deemed ‘natural experiments’ where researchers evaluate physical activity levels before and after a change is made to a community. Such changes can include longer term actions such as the opening of a rail line, or nearer term land use actions including a new grocery store, bikeway, or park.

Changes that can be evaluated can also be nearer term including the introduction of car-sharing, public bike systems, or location efficient mortgage lending programs. Opportunities exist, where address information is available, to retrospectively evaluate the moderating effect of the built environment on physical activity interventions designed to promote physical activity. Finally, researchers can evaluate physical activity levels of people before and after then move to a more or less walkable environment.

Practitioners in the urban planning and public health fields are in need of tools that can better capture the potential impacts of the built environment on health. Health Impact Assessment has been used for years overseas and in Canada to understand the potential health implications of policy or action, and is growing in popularity in the U.S. HIA training for public health and planning staff could help to expand the use and understanding of HIA, and help to develop and share methods and approaches. Similarly, the cost to health is rarely evaluated in the context of urban planning decision-making, and developing standards and methods for
doing so would help to create a fuller understanding of the financial implications of a transportation investment or a development decision. Tools and models that can be developed or modified to include public health outcomes will be useful as well. For example, in a project for King County, Washington (the Seattle region), the authors partnered with the Sacramento Area Council of Governments to enhance the I-PLACE3S sketch planning model. Information on relationships between the built environment and physical activity were programmed into the model, creating an automated tool that can estimate the physical activity impacts of development decisions and/or transportation system changes in King County. Such tools can streamline the HIA process and even more importantly, can elevate health indicators alongside evaluative metrics traditionally used in the planning field.

Discussion

Mounting evidence documents that several aspects of the built environment are related with physical activity. Walking and biking are primary forms of physical activity and are available to most people. Evidence suggests that the engagement in active transportation is perhaps among the most positively and strongly correlated aspects of physical activity with community design. Conversely, time spent in cars is inversely related with community design features and private vehicle use is a sedentary activity. Transit use is synergistic with walking and physical activity levels and provides the ability to concentrate land uses to the extent required to create walkable and bikeable environments. Vehicle ownership levels predispose people to travel choices; partially due to the sunk costs associated with owning cars. Vehicle ownership is related with neighborhood design—even when adjusting for income levels.

The Market

Recent evidence suggests that people with similar preferences for neighborhood design features and travel options make different travel choices depending on the environments in which they live. Foremost, evidence is clear that there is an unmet demand for more walkable environments. The pent up demand for more walkable environments is perhaps best evidenced in housing and land values. One new study correlated property values to the 100-point scale used by Walk Score (www.walkscore.com). The results showed that a 10 point increase in walkability increases property values by 5 to 8%, depending on property type. Not everyone lives in the type of environment they prefer, and many that want to live in walkable places are priced out due to the lack of supply relative to demand for such places.

Those who prefer and also live in walkable environments are more physically active. One study showed that among respondents preferring walkable environments, those living in a walkable environment reported more walking and less driving (34% walked and average daily vehicle miles traveled was 26) compared with those living in unwalkable environments (16% walked and average daily vehicle miles traveled was 37). The built environment may well be an enabler or disabler of physical activity and vehicle use.

A wide range of actions are available to decision makers, planners, and health officials to promote physical activity through the design of the built environment. Short, medium, and long range actions can promote physical activity. Many of these actions are synergistic with other actions and work best when implemented as a package together. Foremost, major changes in the pricing of transportation options will clearly be needed to shift the demand away from cars to walking, biking, and transit. A comprehensive set of pricing reforms are needed that impact the ownership and operation of private vehicles, the relative time it takes to travel by car or transit regionally, the ability to walk and bike safely within communities, and the selection of communities in which to live. In the longer term, actions are required that increase the supply of walkable and bikeable environments for both utilitarian travel and to support and enable recreational activities.

Regulatory actions are also needed to promote physical activity. Development regulations include subdivision regulations impacting neighborhood design (street connectivity), zoning which effects the use of land (mixed use, density, and setbacks), and building codes (stair placement, materials used). Changes to these regulations to support rather than hinder physical activity are required.

The shifts in funding priorities and regulatory processes within transportation and land development industries required to create a healthier future for Americans is perhaps best underpinned by the need to match the supply with the demand for such places. Distortions in pricing and regulatory structures create market failures results in situations where the demand and supply of commodity (walkable environments) becomes misaligned. For example, in suburban areas zoning regulations often prohibit compact, mixed-use development, resulting in a limited amount of residential development within walking distance of destinations. The health and environmental costs of this misalignment, or externalities, would be best mitigated by actions that increase the supply of walkable environments to a level that matches the demand. Doing so would better fulfill the requirements of the precautionary principle when taking into account the health and environmental costs of the built environment.
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