## Commission Briefing Paper 4D-07

# Identification of the Relationships Among Surface Transportation Infrastructure Design, Land Use and Public Health

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### Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

"Public health" incorporates a variety of personal and environmental issues that could be impacted by land use, transportation infrastructure and the built environment. Other Commission briefing papers address other public health related issues such as safety, security, air quality and air toxic emissions, noise, climate change, etc.

This paper presents information on the relationship among land use, transportation design and physical health. The Transportation Research Board (TRB) and the Institute of Medicine recently published a report addressing this issue. The paper is taken largely from TRB Special Report 282 *Does the Built Environment Influence Physical Activity*[i].

### Background and Key Findings

- Scientific evidence strongly supports that regular physical activity reduces the risk of premature mortality and the development of numerous chronic diseases, improves psychological well-being, and helps prevent weight gain and obesity.

- Opportunities to increase physical activity levels exist in many settings – at home, at work, at school, in travel, and in leisure. The built environment has the potential to influence physical activity in each of these settings.

- The role of the built environment in physical activity levels is a relatively new area of inquiry. The science is not sufficiently advanced to determine causal connections or to identify those characteristics of the built environment most closely associated with physical activity behavior.

- Changes in the built environment may have contributed to the decline in physical activity levels, but the specific contribution that the built environment could make in rebuilding physical activity into the daily routine is not well understood.

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- Today's built environment is based on long standing policies typically implemented and enforced by local jurisdictions. Building and site design requirements, zoning, street design standards and land use policies are established by local jurisdictions and are based on many factors.

- Changes to the built environment that would affect physical activity levels would most likely occur over long periods of time as a result of actions by numerous individual local jurisdictions and decision makers.

## Physical Activity and Health

The United States is facing an urgent health issue as increasing numbers of American are overweight or obese. An estimated 30 percent of U.S. adults aged 20 years and older - over 60 million people - are obese, defined as having a body mass index (BMI) of 30 or higher. An estimated 65 percent of U.S. adults aged 20 years and older are either overweight or obese, defined as having a BMI of 25 or higher[ii]. Further, obesity rates for children 6 to 11 years old increased to almost 19 percent in 2004, and are projected to increase to over 20 percent by 2010.[iii] Technological advances, reduced physical demands of work, household management, and travel, broadened food options, larger portion sizes, increased sedentary use of leisure time and many other factors contribute to the average American's growing energy imbalance. Weight gain occurs when calories consumed exceed calories expended. Physical activity can improve the energy equation by increasing the number of calories expended.
The U.S. Surgeon General's 1996 report[iv] concluded that the evidence is sufficiently strong to draw a causal relation between physical activity and health outcomes, including reductions in the risk or mortality from all causes. In addition, according to the TRB report:

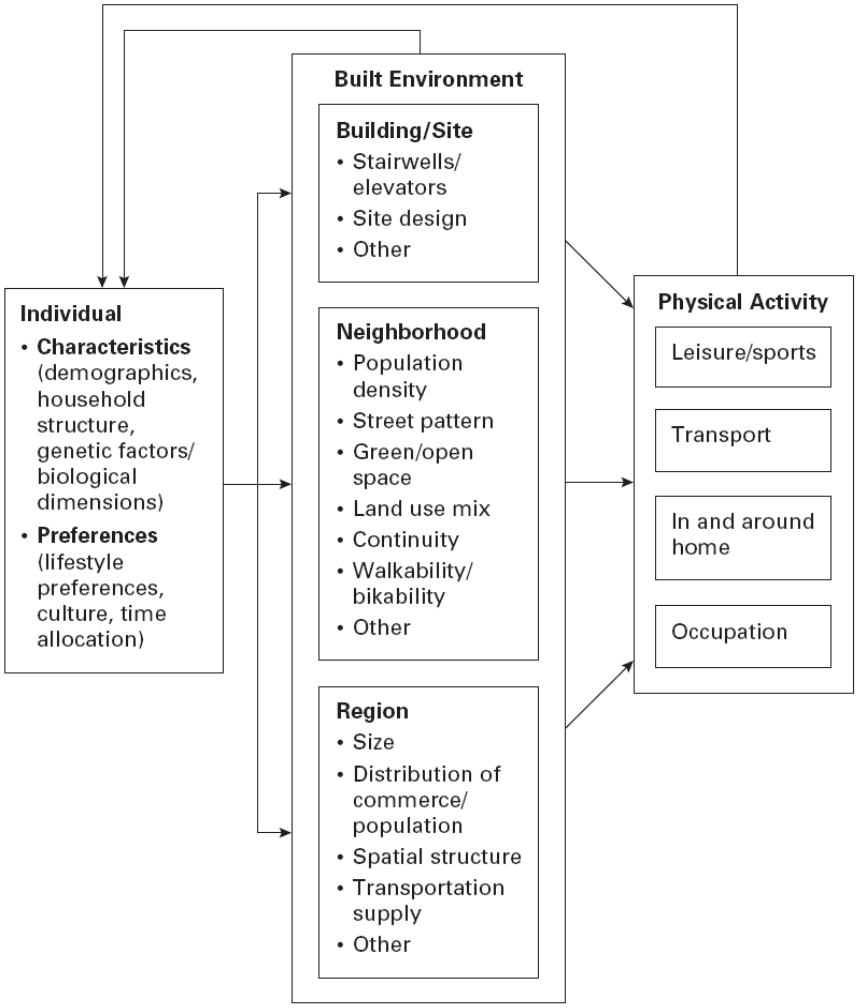
The scientific evidence is compelling that regular physical activity—even at moderate levels, such as walking briskly for 30 minutes on 5 or more days per week—reduces the risk of premature mortality and the development of numerous chronic diseases, improves psychological well-being, and helps prevent weight gain and obesity. Yet, despite the scientific evidence, 55 percent of the U.S. adult population fall short of recommended guidelines, and approximately 25 percent report being completely inactive when not at work. Nearly one-third of high-school-age teenagers report not meeting recommended levels of physical activity, and 10 percent classify themselves as inactive.[v]

There is also an economic impact to overweight and obesity. According to the Centers for Disease Control and Prevention (CDC), direct medical expenses associated with physical inactivity totaled more than $76 billion in 2000. If 10 percent of adults began walking on a regular basis, an estimated $5.6 billion in heart disease costs alone could be saved.[vi]

## Role of the Built Environment

A wide variety of characteristics of the built environment may affect physical activity. The TRB report described the issue using the figure below. The diagram illustrates the complexity of the causal chain from the individual to the built environment to physical activity. For example, if a researcher focuses only on the link between the built environment and physical activity, the role of the built environment could be overstated. If, instead, the researcher steps back and controls

for individual characteristics, including the possibility that the individual may choose or self-select an activity-friendly environment, the independent effect of the built environment on physical activity may be smaller. The diagram also shows several feedback loops. The built environment may influence the individual (for example, living in a neighborhood in which it is pleasant, safe, and easy to walk to stores may induce a more positive attitude toward utilitarian walking; living in a transit-rich area may increase one's propensity to try transit). Physical activity itself may reinforce the propensity of an individual to be physically active.[vii]




## Individual

An individual's level of physical activity can be based on a variety of factors. Demographic factors such as gender, age and ethnic background influence physical activity levels. General level of physical fitness and other biological dimensions also play a role. Further, education and income level can influence both physical activity levels throughout the day as well as available leisure time and access to opportunities for physical activity. In addition, individual attitudes, preferences, motivations, and skills can affect physical activity levels. Finally, individuals must make trade-offs among the various demands on their time and resources. "Despite the tremendous growth in labor-saving technologies during the past century, particularly in the

home, the demands of family, work, and travel limit the time available for physical activity for many individuals, at least during the workweek."[viii]

## Built Environment

Building design features that might influence physical activity include: well-designed and accessible stairs, fewer elevators, layout of pathways, availability of bike racks, showers and exercise rooms. Site design can also encourage or discourage physical activity. Limiting available parking and improving access to transit can increase walk trips. Sidewalks and bike paths can encourage physical activity. Land use mixes and site connectivity would also encourage walk and bicycle trips to a particular site. Several states and local governments have instituted policies that require pedestrian and bicycling facilities be considered or even compelled in conjunction with new road facilities.

The increased availability and accessibility of automobile travel in the twentieth century led to the continued expansion of metropolitan regions and the subsequent reduction in non-motorized travel. According to the TRB report, "two major trends characterized the spatial distribution of population throughout the past century. The first is the population shift from rural to metropolitan areas…The second trend is the movement within metropolitan areas from central cities to the suburbs…The long-term suburbanization of the U.S. population can be traced to broad economic, social, and political changes, as well as the role of federal mortgage insurance programs of the 1950s, the expansion of the Interstate highway system in the 1960s, and the fiscal and social problems of the cities in the 1960s and 1970s (NRC 1999). The suburbanization of the U.S. has resulted in a significant decrease in non-motorized travel. In addition, "the geographic concentration of the poor in central cities generates a host of social ills that accompany poverty…that are likely to discourage poor populations from engaging in physical activity."[ix]

Many organizations, movements and policies and design standards have developed over the last two decades to try to address these issues. Federal, State and local governments, non-profit organizations and foundations, advocacy groups and others promote more town-centered, walkable developments with increased density that accommodate transit and pedestrian activity. These developments have a greater mix of housing, commercial and retail uses while preserving open space and protecting sensitive areas such as wetlands. These new development policies are known by several names, including "new urbanism," "traditional neighborhood design," and "transit-oriented development."

## Safety and Security

Preliminary research does provide some evidence suggesting that such factors as access and safety and security are important for some forms of physical activity, such as walking and cycling, and for some population groups. Urban areas often exhibit the characteristics necessary for significant physical activity: accessible sidewalks and paths, residential density, land-use mix and street connectivity. However, real and perceived concerns about safety, including crime rates, isolation and lack of lighting result in reduced walking and cycling in these neighborhoods. Changes to the built environment, including lighting, site layout and design can address these concerns. Community and social policies including increased law enforcement, litter and graffiti control and strong neighborhood organizations can also help.

Several studies have demonstrated that the built environment design and policies can encourage or promote physical activity. And, it is generally accepted that policies and designs that provide opportunities for, facilitate and encourage physical activity are desirable because of the positive relationship between physical activity and health.

While the TRB report concludes that:

- Opportunities to increase physical activity levels exist in many settings – at home, at work, at school, in travel, and in leisure. The built environment has the potential to influence physical activity in each of these settings; and
- Many opportunities and potential policies exist for changing the built environment in ways that are more conducive to physical activity, but the available evidence is not sufficient to identify which specific changes would have the most impact on physical activity levels and health outcome;

Additional research could result in a better understanding of how to configure the built environment to achieve increased physical activity and improved health.

**Travel Behavior**

We know a bit more about the impact of the built environment on travel behavior than we do about its impact on physical activity. Although uncertainty still exists, good empirical work has been done recently on the impact of: regional employment accessibility on transit use, mixed use development on non-work trips, and greater density on auto use and auto trip length.[x] However, we understand much less about the impact on rates of walking and bicycling. This complicates our ability to understand the built environment / physical activity relationship.

## Active Living

The Robert Wood Johnson Foundation has been a leader in addressing the issues surrounding physical activity and the built environment. It promotes the "active living" concept. As a result of transportation investments, changes in community design, technological advancements, "physical activity has been engineered out of the built environment. Active living is a way of life that integrates physical activity into daily routines. The goal is to accumulate at least 30 minutes of activity each day. Individuals may achieve this by walking or bicycling for transportation, exercise or pleasure; playing in the park; working in the yard; taking the stairs; and using recreation facilities". [xi]

## Land Use and Design Policies

Development patterns in the United States, especially in metropolitan areas, result from the land use, site and building design decisions determined by local governments. The decisions are generally governed by comprehensive plan and zoning regulations. There is little federal role in the regulation of land use (it is mostly not addressed in the U.S. Constitution); and most States have historically delegated that responsibility to local jurisdictions. Counties, cities, towns, villages and other local jurisdictions jealously guard their authority to approve, regulate and tax new development within their borders.

The nation's basic form of land use regulation is zoning, which entails separating the land in a particular area into sections, or zones, with different rules governing the activities on that land.[xii] Zoning codes can be flexible or rigid, specific or general. They can determine any number of site design issues including: size of the lot, type of use, size and height of buildings on the lot, density of use, amount of open space, space reserved for transportation and other public utilities, etc. Zoning and land use control has generally been supported by the American public, developers and realtors because it provides stability and certainty to the market. In the last few decades, various movements have developed to recommend changes to the standard land use and zoning policies that have come into being since the 1950s. These policies are generally not coordinated with policies in neighboring jurisdictions or regional or state goals, often favor single-use districts rather than mixed-use development, favor suburban car-oriented development patterns over non-motorized travel modes and do not address opportunities for physical activity.

Recently, several states and local jurisdictions have adopted growth management efforts to influence the pattern of growth and development to meet projected needs, as opposed to growth control which limits or rations development.[xiii] Many jurisdictions are updating their land use regulation "toolbox" to address a variety of community goals. If research demonstrates that specific site layout, design or other enhancements are correlated to increased physical activity, local jurisdictions could be encouraged to incorporate them into their land use regulations.

**Context Sensitive Solutions**

In the past, surface transportation infrastructure design was governed by mobility, safety and economic goals. The basic geometric design criteria that establishes the physical features of a roadway is guided by the American Association of State Highway and Transportation Official's "Green Book," *A Policy on Geometric Design of Highways and Streets*. The 1998 conference "Thinking Beyond the Pavement: A National Workshop on Integrating Highway Development with Communities and the Environment while Maintaining Safety and Performance" represented a change in the way state and local engineers use the standards in the "Green Book" and resulted in the Context Sensitive Solutions (CSS) approach. CSS is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility.[xiv] FHWA, AASHTO, the Institute of Transportation Engineers and other organizations have published various guides and recommended practices to illustrate the flexibility already available to designers within adopted State standards. These guides emphasize the flexibility to achieve a design that both meets the objectives of the project, emphasizes non-motorized transportation modes and increases opportunities for physical activity. Additional emphasis on CSS approaches in surface transportation infrastructure implementation could result in more diverse transportation choices and more opportunities for integrating physical activity into daily life.

## Consideration of Physical Activity and Public Health in Surface Transportation Infrastructure Design Decisions

The transportation planning and project development process has historically addressed walking and bicycling modes peripherally, but could be strengthened to increase emphasis in this area to promote physical activity. For example, Title 23 of the U.S. Code Section 217 calls for the consideration, where appropriate, of bicycle transportation facilities and pedestrian walkways in

conjunction with all new construction and reconstruction of transportation facilities except where bicycle and pedestrian use are not permitted. The Federal Transit Administration evaluates transit supportive land use plans and policies as part of its *New Starts* project justification criteria. Additional emphasis could be placed on these considerations during the planning and decision making process.

Serious consideration of non-motorized transportation modes is limited by a number of factors. How transportation networks and urban areas are represented in models, the underlying assumptions of travel motivation and the use of average system performance measurements ignore or limit the consideration of walkable communities and non-motorized transportation. Further, quality data on the use of non-motorized modes is difficult to acquire. For example, some suggest that the U.S. Census undercounts walk or bicycle trips as well as the segments of the population most likely to use those modes.[xv] Recently data from the National Household Travel Survey have been used to measure bicycle and pedestrian use, but that Survey is typically conducted every seven years so shorter term usage trends are difficult to track.

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i Transportation Research Board. 2005. *Does the Built Environment Influence Physical Activity? Examining the Evidence, Special Report 282*, Washington D.C.
ii National Center for Health Statistics. *Prevalence of Overweight and Obesity Among Adults: United States, 1999-2002*, Hyattsville, MD
[iii] Government Accountability Office. 2006. *Childhood Obesity: Factors Affecting Physical Activity*. GAO-07-260R, Washington, D.C.
iv Department of Health and Human Services. 1996. *Physical Activity and Health: A Report of the Surgeon General*, Washington D.C.
[v] *TRB Special Report No. 282*
vi Pratt M, Macera CA, Wang G. 2000 Higher direct medical costs associated with physical inactivity *Physician and Sportsmedicine*
[vii] *TRB Special Report No. 282*
[viii] Ibid
[ix] Ibid
[x] Transportation Research Board. 2003. *Land Use and Site Design Traveler Response to Transportation System Changes, TCRP Report 95*, Washington D.C.
[xi] Active Living by Design website http://www.activelivingbydesign.org/index
[xii] Pendall, R, Puentes, Martin, J. August, 2006. From Traditional to Reformed: A Review of the Land Use Regulations in the Nation's 50 largest Metropolitan Areas. *Research Brief*, Washington, DC: Brookings Institution.
[xiii] Ibid
[xiv] Federal Highway Administration Context Sensitive Solutions website http://www.fhwa.dot.gov/csd/what.cfm
xv U.S. Department of Transportation, Transportation Planning Capacity Building Program. Integrating Health and Physical Activity Goals Into *Transportation Planning: Building the Capacity of Planners and Practitioners, Proceedings of the Portland Roundtable*. Available at http://www.planning.dot.gov/Documents/Health/IntHelathTA.htm as of December 15, 2006.