Factors Associated with Federal Transportation Funding for Local Pedestrian and Bicycle Programming and Facilities

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ABSTRACT

Providing safe, convenient places for walking and bicycling can reduce barriers to participating in regular physical activity. We examined bicycle- and pedestrian-related investments authorized by federal transportation legislation in 3,140 counties in the United States by region, population size and urbanization, social and economic characteristics, and indicators of travel-related walking and bicycling. From 1992 to 2004, states and counties implemented 10,012 bicycle- and pedestrian-related projects representing $3.17 billion in federal expenditures. We found disparities in implementation and system-building outcomes according to population size and location and social and economic indicators. Counties characterized by persistent poverty (odds ratio = 0.69, 95% confidence interval 0.53–0.91) or low educational status (odds ratio = 0.66, 95% confidence interval 0.52–0.84) were less likely to implement projects. Three key policy recommendations for improving public health outcomes are drawn from this research: Improved data tracking, more explicit linkages between transportation projects and public health, and improved planning assistance to underserved communities are all seen as essential steps.

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BACKGROUND

Individuals participating in as little as 30 min of moderate-intensity physical activity per day have decreased risk for numerous health conditions (1,2). However, the US population is largely sedentary. In 2005, the prevalence of adults who engaged in moderate physical activity ranged from 33% to 62% across states and territories in the United States (3). Among adults meeting national recommendations of 30 min or more of physical activity on 5 or more days per week, walking was the most common type of activity (4). One approach to increase population levels of physical activity is to encourage walking and bicycling as part of daily travel (5,6). This suggests the increasing importance of capitalizing on the synergy between public health and transportation initiatives. Travel-related walking and bicycling are associated with decreased adiposity (7,8) and weight gain (9) and reductions in cardiovascular (10) and mortality risks (11).

Travel-Related Walking and Bicycling in the United States

In 2001, approximately 9.5% of total trips in the United States were accomplished via walking (8.7%) or bicycling (0.8%) (12), and since 1977 the proportion of vehicular trips has increased while the proportion of walking trips has declined (13). In 2000, according to the US Census, just 2.9% of the population walked and 0.4% bicycled as their usual means of transportation to work (14), a decline from 1960 when 9.9% of workers walked to their workplaces (15). Recent analyses also suggest declines over time in the proportion of children who walk or bicycle to school (from 40.7% in 1969 to 12.9% in 2001) (16). Internationally, there are countries with much higher proportions of urban travel that is accounted for by bicycling and walking (17), indicating a potential for increases in utilitarian physical activity in the United States.

Improving Environments for Physical Activity Through Federal Transportation Policy

In 1990, the US Department of Transportation adopted a new national transportation strategy that sought to increase walking and bicycling and encourage planners and engineers to accommodate

the needs of pedestrians and bicyclists in designing transportation infrastructure in urban and suburban areas (12). There is growing scientific evidence that features of the built environment such as sidewalks, accessible trails and parks, lighting, and traffic patterns are associated with participation in activities such as walking and bicycling (18,19). Providing safe, convenient places for walking and bicycling can reduce barriers to using regular physical activity for transport or leisure. The specific goals of the US Department of Transportation strategy, later outlined in the 1994 National Bicycling and Walking Study, were to double the percentage of total trips made by bicycling and walking and to simultaneously reduce by 10% the number of bicyclists and pedestrians killed or injured in traffic crashes (12).

Transportation Funding Mechanisms

Although local and state funding sources are important, federal transportation funding is an essential source of financial support for creating, improving, and maintaining bicycle and pedestrian infrastructure and facilities. In the United States, the federal Department of Transportation provides substantial funding for all transportation-related projects. The Federal Highway Administration is the lead agency within the US Department of Transportation, overseeing program administration and providing financial and technical support to state and tribal governments that administer the programs locally. The Federal Highway Administration budget for transportation comes primarily from fuel and motor vehicle excise taxes. Approximately every 7 years, transportation bills are passed by the US Congress to authorize the use of these funds for various Federal Highway Administration programs. Although the Federal Highway Administration was originally created to focus on roads and highways, the passage of the Intermodal Surface Transportation Efficiency Act (20) in 1991 marked a shift towards a multi-modal approach to surface transportation by creating new objectives, programs, and planning requirements for bicycle and pedestrian activities. Following the Intermodal Surface Transportation Efficiency Act, the Transportation Equity Act for the 21st Century (21), enacted in 1998, authorized program funding for another 6 years. In 2005, the latest in the new generation of transportation

bills, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (22) was passed, authorizing transportation funding through 2009 (23).

Bicycle and pedestrian improvements are eligible for funding under several of the Federal Highway Administration programs established in these transportation bills. The Surface Transportation Program is the largest federal highway program, providing flexible funding for multiple types of surface transportation projects (24). The Transportation Enhancements program provides funding for improvements in pedestrian and bicycle facilities, safety and education programs, and preservation of abandoned rail trails (i.e., for conversion to bicycle and pedestrian trails) (25). Other sources of support include the Congestion Mitigation and Air Quality Improvement Program (26), intended for geographical areas that do not meet the National Ambient Air Quality Standards (considered to be "non-attainment areas"), or to former non-attainment areas, and the Recreational Trails Program (27), a smaller but prominent program for bicycle and pedestrian improvements. These congressionally directed transportation programs are administered by the US Department of Transportation. Additionally, the Transportation Community and System Preservation Program (28) and the High Priority Projects Program (29) are established programs that allow members of Congress to earmark (i.e., directly fund) projects they identify in a transportation bill.

After Congress appropriates money for each transportation program, various program-specific formulas are used to apportion the program monies among the states. Within the yearly congressionally determined limit on each state's apportionment, states have considerable authority and flexibility to determine how to distribute funding among these programs (30). State transportation departments conduct short- and long-term planning activities and work together with regional planning agencies and other stakeholders to determine the state spending on specific transportation projects. To be responsive to distinct regional transportation needs, the Intermodal Surface Transportation Efficiency Act and its successors both permitted and required metropolitan areas to establish their own transportation goals and objectives through a series of transportation plans developed by Metropolitan Planning Organizations (31). In metropolitan areas, the Metropolitan Planning

Organizations must work in partnership with state Departments of Transportation to implement selected projects. Although the majority of federal transportation funding (and state-derived funding) is received and managed by state departments of transportation, states use different strategies in apportioning funds to sub-state regions, with some states distributing funding evenly among counties and other states using various transportation need-based formulas (32).

Although prior reports have documented federal investments at the state level, there has been little attention to national patterns of bicycle and pedestrian investments at local levels. In the following exploratory analyses, we document implementation of projects and identify patterns of investment in bicycling and pedestrian programming and facilities in US counties according to region, population size and urbanization, social and economic factors, and indicators related to travel-related walking and bicycling. We then use these findings as the basis for several policy and research recommendations.

METHODS

Measures

Federal expenditures on bicycle and pedestrian projects

We obtained data on federal obligations (i.e., funding) for bicycle- and pedestrian-focused projects by year for each state between 1990 and 2004, corresponding to the period just before the enactment of the Intermodal Surface Transportation Efficiency Act (December 1991) through the conclusion of funding authorized by the Transportation Equity Act for the 21st Century. (Funding obligated via the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, the current transportation legislation, is not included in this analysis.) These data, from the Fiscal Management Information System of the Federal Highway Administration, include funding changes to projects (i.e., increases or decreases) that occurred through October 2006. Amount in dollars of funding obligation is reported in the year of spending, over the course of the project, and does not include adjustment for inflation. Fiscal Management Information System data identify projects according

to type (i.e., bicycle/pedestrian facilities or infrastructure, safety/education projects, and preservation of abandoned rail corridors), year of initiation, county and state of implementation, funding program (e.g., Congestion Mitigation and Air Quality Improvement Program, Surface Transportation Program, Transportation Enhancements), and legislative source (e.g., the Intermodal Surface Transportation Efficiency Act, the Transportation Equity Act for the 21st Century). A small percentage of funding (5.7%) was implemented in statewide or multi-county projects. The Fiscal Management Information System is the only source of data on federal expenditures for bicycle and pedestrian improvements covering all federal transportation programs. However, the Fiscal Management Information System only tracks federal expenditures, not the total amount spent on projects, and relies on states to identify bicycle and pedestrian projects.

Primary Study Outcome Variables

Past research has indicated that the micro-level site design characteristics of a community, including connected pedestrian systems (i.e., system building), play a role in non-motorized, or active, transportation use (i.e., walking or bicycling) (33). Although potentially preferable, obtaining data on local specific design features of non-motorized transportation systems was not feasible, given the national scope of this study. However, our analysis used four separate but related outcome measures of federal policy implementation: (1) whether the pedestrian- or bicycle-related project was implemented in a given county during the study period (dichotomous (yes/no) outcome), (2) funding per capita, (3) the total number of projects undertaken per county, and (4) the number of years when projects were initiated per county during the study period. For analysis, per capita funding obligation and the numbers of years and numbers of projects implemented were log transformed to correct for their positively skewed, non-normal distributions.

Other Study Measures

Urban, rural, and regional identification

To characterize counties, we used the 2003 Urban Influence Codes from the US Department of Agriculture, Economic Research Service

(34). The urban influence codes characterize counties according to population size, urbanization, and access to larger economies. Researchers aggregated 12 Urban Influence Codes into four "county-types": (1) large metropolitan areas: counties with at least 1 million residents, (2) small metropolitan areas: counties with fewer than 1 million residents, (3) micropolitan areas: non-metropolitan counties with an urban cluster of at least 10,000 residents, and (4) non-core areas: non-metropolitan counties without an urban cluster of 10,000 residents. Researchers posited that investment would differ systematically by county type due to several functional factors (e.g., land access, new development patterns) and thus should be accounted for in examining other study covariates of interest to improve practical interpretation of findings for policy. These counties were also classified by US Census regions (i.e., Northeastern, Central, Southern, and Western), in order to examine regional variability in implementation.

Social and Economic Indicators

We used existing social and economic measures (i.e., 2004 Typology Codes) available from the US Department of Agriculture, Economic Research Service (35). For analysis, we selected two social and economic indicators representing components of access to human and economic capital: (1) low education: counties where 25% or more of residents 25–64 years of age had neither a high school diploma nor a General Educational Development credential (high school diploma equivalent achieved by passing a series of General Educational Development tests) in 2000, and (2) persistent poverty: counties where 20% or more of residents were poor as measured by the census in 1970, 1980, 1990, and 2000. These variables were included as dichotomous indicators in statistical models.

Transportation Mode Indicators

We obtained county-level US Census data for 2000 from GeoLytics Inc. (36) and the 2004 county boundaries from ESRI (37). Owing to small differences in county designations, we created a single data set with 3,140 counties in order to best match data from these multiple sources. We calculated three county-level factors related to physically

active travel modes using US Census 2000: (1) proportion of households with no vehicle, (2) proportion of households with two or more vehicles (selected to represent both ends of the spectrum of household car dependence), and (3) the proportion of employed persons whose mode of journey to work includes walking, bicycling, or public transportation (representing use of alternative transportation modes other than a private car). Although not specifically a nonmotorized form of transportation itself, use of public transportation often entails walking (38).

Analysis

We first examined distributions of bicycle and pedestrian project implementation by year, by program type (e.g., Transportation Enhancements, Congestion Mitigation and Air Quality Improvement Program), by funding legislation (e.g., the Intermodal Surface Transportation Efficiency Act, the Transportation Equity Act for the 21st Century), and across states; regions; county types; and social, economic, and travel-related county characteristics.

We calculated ANOVA *F* statistics as well as chi-squares from the Kruskal–Wallis test to test for overall differences in outcomes by county type. Then, using SAS version 9.2 PROC MIXED and PROC GLIMMIX (39), we calculated two-level logistic or linear regression models, depending on the outcome, that accounted for clustering of counties within given states. Regression models predicting the log odds of having implemented a bicycle or pedestrian project during the study period were estimated initially with indicators for county type, then separately with other study covariates. This analysis series included all 3,140 counties. Next, we estimated regression models predicting the remaining three outcomes (i.e., per capita obligated funds, number of projects, and number of years at least one project was implemented) among those 1,938 counties that had implemented at least one project.

In each case, the two-level model (i.e., counties nested within states) is a random-intercept model that uses the data to estimate the variance in the outcome across states. The intercept parameter is assumed to randomly vary at the state level, allowing for differing average state funding input. The effects of the other county-level covariates are considered "fixed effects," whose effect on a given

outcome is constant for the specific county characteristic (e.g., large metropolitan, small metropolitan, micropolitan, and non-core) (40). We estimated statistical models with each social and economic indicator and transportation indicators separately, controlling for county type.

RESULTS

Overall Implementation

Between 1992 and 2004, $3.17 billion in federal transportation funding was obligated to states and local communities to implement 10,012 projects including improvements to facilities for bicyclists and pedestrians, preservation of abandoned railway corridors, and bicycle and pedestrian safety and education programs. The number of bicycle and pedestrian projects identified in the Fiscal Management Information System increased upon enactment of the Intermodal Surface Transportation Efficiency Act in December 1991. By 1993, the number of bicycle and pedestrian projects with obligated funding was twice that of the three prior years combined. The level of yearly funding and the numbers of projects funded in a given year are correlated and fluctuate with the life-course of the federal legislation. Obligated federal funding peaked in 2002, with just over $450 million allocated to bicycle and pedestrian projects, after starting with approximately $38 million in 1992 (Figure 1).

Approximately 94% of projects were facility-related projects, such as replacing or adding sidewalks or installing bicycle storage facilities. Of total projects, 4% were related to preservation of abandoned railways and 2% were safety and education programs for bicyclists and pedestrians. The majority of projects (56%) were funded under the Transportation Equity Act for the 21st Century. The total number of projects implemented differed by program type (73% Transportation Enhancements, 8% Surface Transportation Program, 7% Congestion Mitigation and Air Quality Improvement Program, 4% Recreational Trails Program, <1% through the Transportation Community and System Preservation Program and the High Priority Projects Program, respectively, and 6% through other programs). Annual per capita expenditures across states varied and are presented in Figure 2.

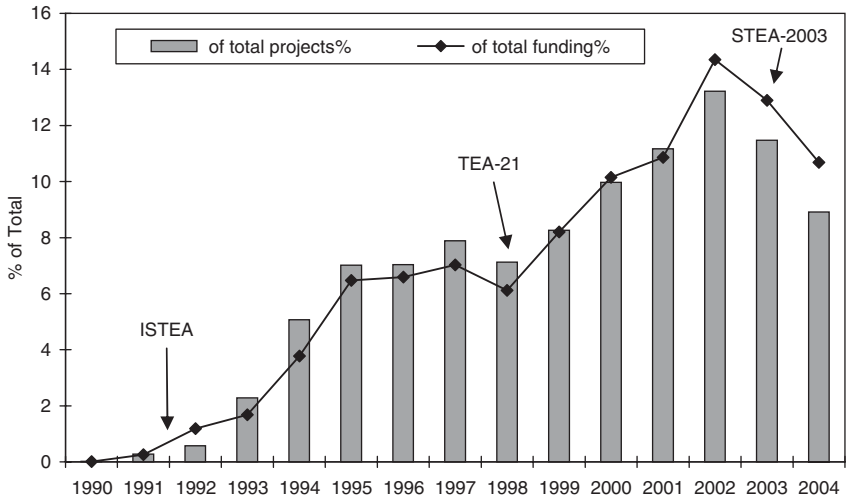

Figure 1
Yearly percentages of total bicycle- and pedestrian-related projects and federal funding obligations implemented between 1990 and 2004, Fiscal Management Information System 1990–2004 ISTEA, Intermodal Surface Transportation Efficiency Act; STEA-2003, Surface Transportation Extension Act-2003; TEA-21, Transportation Act for the 21st century

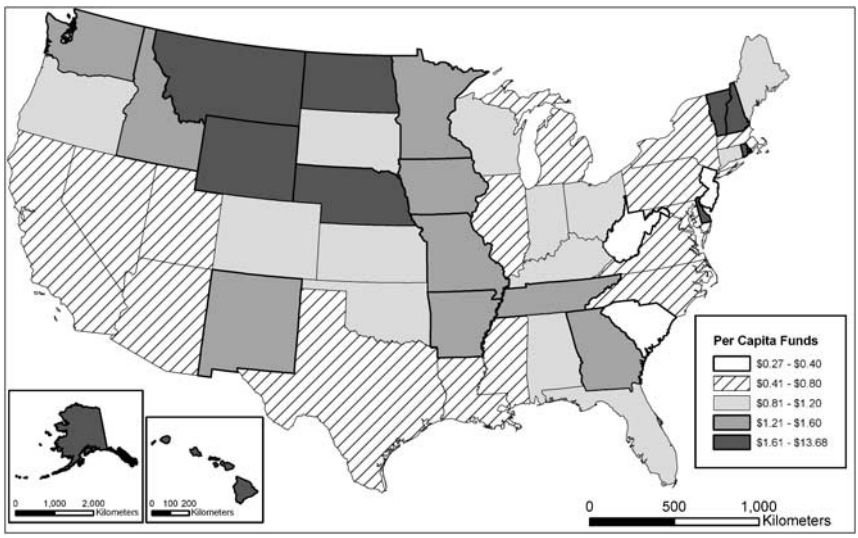

Figure 2
Average annual per capita US federal funding obligations for bicycle and pedestrian projects by state, Fiscal Management Information System 1992–2004

County-Specific Implementation

Overall, 1,938 or 61.7% of US counties had one or more bicycle- or pedestrian-related project(s). The overall median project cost was $179,850. Table 1 depicts the county-level medians, means, and standard deviations for the implementation outcomes, overall and by county type. Among counties implementing bicycle and pedestrian projects, large metropolitan counties received lower average annual per capita funding obligations than other county types but had the highest median average project cost ($320,905).

County Characteristics Associated with Bicycle and Pedestrian Project Implementation

The likelihood of having a project in a county differed by county type, with micropolitan and non-core counties being less likely to have a project than large metropolitan counties (Table 2). Compared with the Northeast, counties in the Southern and Central regions of the United States were less likely to implement a project, independent of county typology. In separate models, counties characterized by low educational attainment and persistent poverty of residents were significantly less likely than counties without these characteristics to have implemented projects, independent of county typology. Among transportation mode indicators, increased percentage of households with two or more cars was associated with a decreased likelihood of having implemented a bicycle- or pedestrian-related project during the study period. Both the proportion of households with no car and the proportion of workers walking, bicycling, or taking public transit to work were not significantly associated with the likelihood of implementing a project.

Per Capita Funding Obligation

Among the 1,938 counties implementing at least one bicycle or pedestrian project, per capita funding obligation differed significantly by county type and by region (Table 3). Per capita funding obligations were significantly higher in small metropolitan, micropolitan, and non-core counties compared with large metropolitan counties. Independent of county type, location in the Western region was positively associated with per capita funding obligations when

Table 1: Descriptive statistics on implementation and system building outcomes among those counties that implemented bicycle and pedestrian projects, n=1,938 counties in 50 states and the district of Columbia, Fiscal Management Information System 1992–2004

County type	*All US counties*		*Counties with project*			*Overall study period (1992–2004)*		
	n	*%*	*n*	*%*		*Median*	*Mean*	*SD*
Large metropolitan county	413	13.2	315	76.3	Average annual per capita obligation*	$0.62	$1.10	$2.40
					Average annual total obligated funding in county†	$104,922	$307,441	$471,325
					Number of projects in each county‡	4.0	8.9	11.9
					Count of years funding obligated by county§	3.0	4.1	3.0
					Average cost per project¶	$320,905	$437,931	$589,055
Small metropolitan county	676	21.5	521	77.1	Average annual per capita obligation	$0.88	$1.31	$1.71
					Average annual total obligated funding in county	$84,763	$156,323	$216,212
					Number of projects in each county	4.0	7.0	7.7
					Count of years funding obligated by county	3.0	3.9	2.6
					Average cost per project	$211,289	$325,089	$385,660

Table 1 *(continued)*

County type	*All US counties*		*Counties with project*			*Overall study period (1992–2004)*		
	n	%	*n*	%		*Median*	*Mean*	*SD*
Micropolitan county	675	21.5	459	68.0	Average annual per capita obligation	$0.80	$1.70	$3.57
					Average annual total obligated funding in county	$32,855	$63,551	$102,321
					Number of projects in each county	2.0	3.6	3.9
					Count of years funding obligated by county	2.0	2.6	1.9
					Average cost per project	$169,584	$251,573	$300,002
Non-core county	1,376	43.8	643	46.7	Average annual per capita obligation	$1.41	$3.13	$9.45
					Average annual total obligated funding in county	$18,746	$33,990	$65,117
					Number of projects in each county	2.0	2.4	2.1
					Count of years funding obligated by county	1.0	1.9	1.3
					Average cost per project	$127,024	$196,238	$416,033

Table 1 *(continued)*

County type	*All US counties*		*Counties with project*			*Overall study period (1992–2004)*		
	n	%	*n*	%		*Median*	*Mean*	*SD*
Overall	3,140	100	1,938	61.7	Average annual per capita obligation	$0.97	$1.97	$5.92
					Average annual total obligated funding in county	$36,916	$118,325	$248,432
					Number of projects in each county	2.0	5.0	7.1
					Count of years funding obligated by county	2.0	3.0	2.4
					Average cost per project	$179,850	$283,267	$426,541

SD, standard deviation.

*ANOVA F test: $F_{3,1,934}=13.2$, $P<0.0001$; Kruskal–Wallis test: $\chi^2=112.4$, d.f.=3, $P<0.0001$; Significant variability in average annual per capita obligation by county type.

†ANOVA F test: $F_{3,1,934}=114.0$, $P<0.0001$; Kruskal–Wallis test: $\chi^2=411.1$, d.f.=3, $P<0.0001$; Significant variability in average annual total obligated funding by county type.

‡ANOVA F test: $F_{3,1,934}=92.2$, $P<0.0001$; Kruskal–Wallis test: $\chi^2=276.7$, d.f.=3, $P<0.0001$; Significant variability in number of projects in each county by county type.

§ANOVA F test: $F_{3,1,934}=114.9$, $P<0.0001$; Kruskal–Wallis test: $\chi^2=274.3$, d.f.=3, $P<0.0001$; Significant variability in count of years funding obligated by county type.

¶ANOVA F test: $F_{3,1,934}=26.2$, $P<0.0001$; Kruskal–Wallis test: $\chi^2=209.6$, d.f.=3, $P<0.0001$; Significant variability in average project cost by county type.

Table 2: Odds ratio (OR) and 95% confidence intervals (95% CI) from logistic regression predicting the likelihood of bicycle and pedestrian project implementation, n=3,140, Fiscal Management Information System 1992–2004

County type and region			*Social and economic*			*Transportation*		
Variable	*OR*	*95% CI*	*Variable*	*OR*	*95% CI*	*Variable*	*OR*	*95% CI*
Large metro county	1.00	Referent	Large metro county	1.00	Referent	Large metro county	1.00	Referent
Small metro county	0.94	(0.68–1.29)	Small metro county	0.95	(0.69–1.30)	Small metro county	0.93	(0.68–1.28)
Micropolitan county	0.59	(0.43–0.80)	Micropolitan county	0.61	(0.45–0.84)	Micropolitan county	0.58	(0.42–0.80)
Non-core county	0.23	(0.17–0.31)	Non-core county	0.25	(0.18–0.33)	Non-core county	0.23	(0.17–0.30)
			Non-persistent poverty county	1.00	Referent	% Households with 0 cars*	1.01	(0.99–1.04)
			Persistent poverty county	0.69	(0.53–0.91)			
Large metro county	1.00	Referent	Large metro county	1.00	Referent	Large metro county	1.00	Referent
Small metro county	0.95	(0.69–1.30)	Small metro county	0.96	(0.70–1.32)	Small metro county	0.84	(0.61–1.16)
Micropolitan county	0.60	(0.44–0.81)	Micropolitan county	0.64	(0.46–0.87)	Micropolitan county	0.49	(0.36–0.68)
Non-core county	0.23	(0.18–0.31)				Non-core county	0.19	(0.14–0.26)

Table 2 *(continued)*

County type and region			*Social and economic*			*Transportation*		
Variable	*OR*	*95% CI*	*Variable*	*OR*	*95% CI*	*Variable*	*OR*	*95% CI*
Northeast region	1.00	Referent	Non-core county	0.26	(0.19–0.34)	% Households with 2+ cars*	0.96	(0.95–0.98)
Central region	0.19	(0.07–0.50)	Non-low education county	1.00	Referent			
Southern region	0.21	(0.08–0.53)	Low education county	0.66	(0.52–0.84)			
Western region	0.49	(0.18–1.33)						
						Large metro county	1.00	Referent
						Small metro county	0.95	(0.69–1.31)
						Micropolitan county	0.60	(0.44–0.82)
						Non-core county	0.23	(0.17–0.31)
						% Bicycle/walk/ transit*	1.02	(1.00–1.05)

*Effect of continuous variables are assessed as one unit offsets from the mean.
Persistent poverty county – 20% or more of residents were poor as measured by 1970, 1980, 1990, and 2000 census.
Low education county – 25% or more of adult residents had neither a high school diploma nor a GED in 2000.

Table 3: Parameter estimates and standard errors (SE) for models predicting (log) of per capita funding obligations at the county level among counties with one or more projects (n=1,938), Fiscal Management Information System 1992–2004

County type and region				*Social and economic*				*Transportation*			
(Log) per capita funding obligation											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Intercept	2.40	0.10	<0.0001	Intercept	2.40	0.10	<0.0001	Intercept	2.46	0.11	<0.0001
Small metro county	0.27	0.07	0.0001	Small metro county	0.27	0.07	0.0001	Small metro county	0.27	0.07	0.0001
Micropolitan county	0.19	0.07	0.0102	Micropolitan county	0.19	0.07	0.0102	Micropolitan county	0.19	0.07	0.0103
Non-core county	0.53	0.07	<0.0001	Non-core county	0.53	0.07	<0.0001	Non-core county	0.53	0.07	<0.0001
				Persistent poverty county	−0.01	0.08	0.8821	% House holds with 0 cars	−0.01	0.01	0.1184
Intercept	2.37	0.20	<0.0001	Intercept	2.39	0.10	<0.0001	Intercept	2.27	0.22	<0.0001
Small metro county	0.27	0.07	0.0002	Small metro county	0.28	0.07	<0.0001	Small metro county	0.28	0.07	0.0001
Micropolitan county	0.18	0.07	0.0137	Micropolitan county	0.21	0.07	0.0037	Micropolitan county	0.19	0.07	0.0089
Non-core county	0.52	0.07	<0.0001	Non-core county	0.57	0.07	<0.0001	Non-core county	0.53	0.07	<0.0001

Table 3 *(continued)*

County type and region				*Social and economic*				*Transportation*			
(Log) per capita funding obligation											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Central region	0.01	0.25	0.9534	Low education county	−0.17	0.07	0.0139	% House holds with 2+ cars	0.00	0.00	0.5243
Southern region	−0.32	0.23	0.176								
Western region	0.52	0.25	0.0414								
								Intercept	2.30	0.10	<0.0001
								Small metro county	0.30	0.07	<0.0001
								Micropolitan county	0.21	0.07	0.0041
								Non-core county	0.54	0.07	<0.0001
								% Bicycle/ walk/transit	0.01	0.00	0.0065

Reference category is the large metropolitan county.
Persistent poverty county – 20% or more of residents were poor as measured by 1970, 1980, 1990, and 2000 census.
Low education county – 25% or more of adult residents had neither a high school diploma nor a GED in 2000.

compared with the Northeast region (referent category). Counties characterized by low levels of population educational attainment were associated with lower levels of per capita funding compared with counties with residents achieving higher levels of education, independent of county type. Additionally, the proportion of employed county residents that commute to work via bicycle, walking, or public transit was directly associated with higher per capita funding.

Bicycle and Pedestrian Transportation Project Investment

Tables 4 and 5 indicate that both micropolitan (non-metropolitan counties with an urban cluster of at least 10,000 residents) and non-core (non-metropolitan counties without an urban cluster of 10,000 residents) counties are associated with lower levels of bicycle and pedestrian infrastructure and program investments compared with their metropolitan counterparts, as measured by the natural log number of projects initiated and the number of years that new projects were funded. Counties in the Southern region implemented fewer projects and had fewer years of new investments during the project period compared with counties in the Northeast region. Similarly, counties characterized by low educational attainment of residents implemented fewer projects and had fewer years of new project implementation relative to their counterparts with higher educational status of county residents. The proportion of households with no car access was positively associated with both the number of years of new project initiation and the number of projects funded during the study period. The proportion of households with access to two or more cars in a county was inversely associated with project implementation indicators. The proportion of county workers commuting via walking, bicycling, or public transit was positively associated with both the numbers of projects implemented and the number of years in which new bicycle and pedestrian projects were initiated.

DISCUSSION

Federal transportation funding has been an important source of financial support for creating, improving, and maintaining bicycle

Table 4: Parameter estimates and standard errors (SE) for models predicting (log) of number of years funding obligated in the county among counties with one or more projects (n=1,938), Fiscal Management Information System 1992–2004

County type and region				*Social and economic*				*Transportation*			
(Log) number of years funding obligated											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Intercept	1.57	0.05	<0.0001	Intercept	1.57	0.05	<0.0001	Intercept	1.52	0.05	<0.0001
Small metro county	−0.05	0.03	0.1265	Small metro county	−0.05	0.03	0.1268	Small metro county	−0.05	0.03	0.1446
Micropolitan county	−0.37	0.03	<0.0001	Micropolitan county	−0.37	0.03	<0.0001	Micropolitan county	−0.37	0.03	<0.0001
Non-core county	−0.55	0.03	<0.0001	Non-core county	−0.55	0.03	<0.0001	Non-core county	−0.56	0.03	<0.0001
				Persistent poverty county	0.00	0.04	0.975	% with 0 cars	0.01	0.00	0.0097
Intercept	1.68	0.09	<0.0001	Intercept	1.56	0.05	<0.0001	Intercept	2.29	0.10	<0.0001
Small metro county	−0.05	0.03	0.1346	Small metro county	−0.04	0.03	0.1831	Small metro county	−0.07	0.03	0.0303
Micropolitan county	−0.37	0.03	<0.0001	Micropolitan county	−0.36	0.03	<0.0001	Micropolitan county	−0.40	0.03	<0.0001
Non-core county	−0.55	0.03	<0.0001	Non-core county	−0.53	0.03	<0.0001	Non-core county	−0.58	0.03	<0.0001

Table 4 *(continued)*

County type and region				*Social and economic*				*Transportation*			
(Log) number of years funding obligated											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Central region	−0.18	0.11	0.1146	Low education county	−0.10	0.03	0.0016	% with 2+ cars	−0.01	0.00	<0.0001
Southern region	−0.26	0.11	0.0197								
Western region	0.04	0.11	0.7505								
								Intercept	1.52	0.05	<0.0001
								Small metro county	−0.04	0.03	0.2638
								Micropolitan county	−0.36	0.03	<0.0001
								Non-core county	−0.55	0.03	<0.0001
								% Bicycle/ walk/transit	0.01	0.00	0.0012

Reference category is the large metropolitan county.
Persistent poverty county – 20% or more of residents were poor as measured by 1970, 1980, 1990, and 2000 census.
Low education county – 25% or more of adult residents had neither a high school diploma nor a GED in 2000.

Table 5: Parameter estimates and standard errors (SE) for models predicting (log) number of projects implemented at the county level among counties with one or more projects (n=1,938), Fiscal Management Information System 1992–2004

County type and region				*Social and economic*				*Transportation*			
(Log) number of projects implemented											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Intercept	1.99	0.07	<0.0001	Intercept	1.99	0.07	<0.0001	Intercept	1.90	0.08	<0.0001
Small metro county	−0.13	0.04	0.0041	Small metro county	−0.13	0.04	0.004	Small metro county	−0.12	0.04	0.0054
Micropolitan county	−0.62	0.05	<0.0001	Micropolitan county	−0.62	0.05	<0.0001	Micropolitan county	−0.62	0.05	<0.0001
Non-core county	−0.85	0.04	<0.0001	Non-core county	−0.85	0.05	<0.0001	Non-core county	−0.86	0.04	<0.0001
				Persistent poverty county	0.02	0.05	0.6856	% with 0 cars	0.01	0.00	0.0004
Intercept	2.17	0.14	<0.0001	Intercept	1.99	0.07	<0.0001	Intercept	3.18	0.14	<0.0001
Small metro county	−0.13	0.04	0.0045	Small metro county	−0.12	0.04	0.0067	Small metro county	−0.16	0.04	0.0003
Micropolitan county	−0.62	0.05	<0.0001	Micropolitan county	−0.60	0.05	<0.0001	Micropolitan county	−0.66	0.05	<0.0001
Non-core county	−0.85	0.04	<0.0001	Non-core county	−0.83	0.05	<0.0001	Non-core county	−0.89	0.04	<0.0001

Table 5 *(continued)*

County type and region				*Social and economic*				*Transportation*			
(Log) number of projects implemented											
Variable	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*	*Variable*	*Estimate*	*SE*	*Pr>|t|*
Central region	−0.29	0.18	0.1051	Low education county	−0.11	0.04	0.0134	% with 2+ cars	−0.02	0.00	<0.0001
Southern region	−0.41	0.17	0.0181								
Western region	0.06	0.18	0.7189								
								Intercept	1.91	0.07	<0.0001
								Small metro county	−0.11	0.04	0.0168
								Micropolitan county	−0.60	0.05	<0.0001
								Non-core county	−0.84	0.04	<0.0001
								% Bicycle/ walk/transit	0.01	0.00	0.0002

Reference category is the large metropolitan county.
Persistent poverty county – 20% or more of residents were poor as measured by 1970, 1980, 1990, and 2000 census.
Low education county – 25% or more of adult residents had neither a high school diploma nor a GED in 2000.

and pedestrian infrastructure in the United States. Between 1992 and 2004, over 10,000 bicycle- and pedestrian-focused projects representing $3.17 billion in federal expenditures were implemented through multiple federal funding programs. These substantial investments represent an important step toward achieving the Federal Highway Administration goals of doubling the proportion of walking and bicycling trips, while simultaneously decreasing pedestrian and bicycling injuries and fatalities (12). However, implementation of projects serving pedestrians and bicyclists was not uniform.

Our study findings highlight significant disparities in implementation outcomes associated with social and economic factors. Bicycle and pedestrian projects were less likely to have been implemented in counties characterized by persistent poverty and lower educational attainment. Additionally, among only those counties that implemented a project, low educational attainment of adult residents was associated with lower levels of per capita funding and new project initiation. These funding equity considerations are significant, given the important public costs and public health disparities associated with poor air quality (41); pedestrian and bicyclist injuries (42); and physical inactivity (43) and its related health conditions such as obesity (43), diabetes (44), and cardiovascular disease (45). These poor public health outcomes are more likely in areas characterized by socioeconomic disadvantage (46,47).

Levels of implementation differed by county types. Non-metropolitan areas (i.e., micropolitan and non-core counties) were less likely to have implemented any bicycle or pedestrian project, and had fewer projects initiated and fewer years of new project initiation than larger metropolitan areas. The lower likelihood of making any investment in non-motorized transportation infrastructure in non-metro areas may be partly a result of dispersed land use patterns that could make non-motorized transportation projects more difficult to justify as a purely transportation-focused project in accordance with local demand and Federal Highway Administration program guidance. Bicycle and pedestrian projects are clearly suitable and cost effective for transportation in areas with higher population and destination densities. However, in comparing counties with implemented projects, per capita funding was higher in non-metro

counties than in larger metropolitan counties, reflecting what may be an underinvestment in metropolitan areas where travel-related walking and bicycling is most feasible due to destination, population, and street network density (i.e., density of points of intersection among neighboring streets).

Although federal funding has helped to dramatically increase the number of bicycle–pedestrian projects nationwide, the extent of funding does not match estimates of non-motorized user demand. Although trips taken on foot or via bicycle represent a small share of overall total miles traveled, they represent a large share of overall trips taken. With as little as 1.5% of all federal transportation funding potentially spent on projects for bicyclists and pedestrians (48) and 9.4% of all trips made via non-motorized modes of transportation nationally (12), the overall level of funding is out of balance with the proportion of non-motorized trips. Furthermore, bicyclists and pedestrians represent some 12.3% of all traffic fatalities (12). Although the focus of this study was not on public health *per se*, the findings do have potential implications for public health policy and practice – and a call for greater cooperation and coordination between public health and transportation .disciplines. During implementation of the Intermodal Surface Transportation Efficiency Act and the Transportation Equity Act for the 21st Century, the year 2002 saw the largest flow of public funding for bicycle and pedestrian projects ($450 million). However, this expenditure is dwarfed by the estimated annual direct medical costs associated with physical inactivity ($24 billion) and obesity ($70 billion). Together these medical costs account for 9.4% of US health care expenditures (43), a level of spending that recent analysis suggests potentially could be reduced if the US population were to become more physically active in their daily commutes (49).

Future Directions for Research

To our knowledge, this is the first study to document the overall patterns of federal funding for pedestrian and bicycle improvements and examine factors related to the level of funding at the local, county level. Although the Federal Highway Administration has standard practices for reporting project information, including a

system that details the format and specification of data entry completed by states, there is the potential for variability in how program personnel in each state code and enter project data. Additionally, reporting specifications (e.g., criteria by which a project is coded separately as a bicycle or pedestrian project) may have changed over the study period. Counties may differ in their eligibility for funding via specific federal funding programs (e.g., only counties within current or prior National Ambient Air Quality non-attainment areas are eligible for Congestion Mitigation and Air Quality Improvement Program funds). We do not account for county-level program eligibility differences in this analysis. Furthermore, we do not know how well our county-level indicators of bicycle and pedestrian facility and program implementation relate to the level of local adequacy, connectivity (i.e., directness and density of connections in street and sidewalk system that enable walking and bicycling), and availability of pedestrian and bicycle systems, factors that enable local travel by foot or by bicycle. Bicycling and walking occur at a sub-county level; thus further analysis at lower levels of aggregation, preferably using direct performance measures (e.g., non-motorized modal split), would better inform us regarding the effect of federal investments in bicycling and pedestrian infrastructure on increasing rates of travel-related walking and bicycling. Further study could examine the effects of these limitations and enhance knowledge in this research area.

Several factors may have contributed to an underestimation of federal bicycle and pedestrian funding. Although data for individual projects represent the most up-to-date information available, they are point-in-time estimates and are subject to revision. Federal obligations reported have not been adjusted for inflation, resulting in a discounting of the costs of projects whose funding was primarily obligated during early years of study compared with later or multi-year projects. In the Fiscal Management Information System, projects are identified only by year of initial obligation. Also, we may have underestimated implementation of bicycle and pedestrian projects when they were smaller components of a larger motorized transportation project, or projects within programs (e.g., Recreational Trails Program) that typically classify projects as motorized despite both motorized and non-motorized use. Certain costs may

differ systematically by county type (e.g., higher costs of land acquisition in metropolitan counties) or region (e.g., more need for routine maintenance in areas with more extreme weather conditions). The Fiscal Management Information System data only track federal expenditures and not the total amount spent on projects that may include contributions from states (e.g., local match). Other sources of funding for bicycle and pedestrian projects (e.g., matching state or local–added funding) can vary locally, were not available in the Fiscal Management Information System data, and are not accounted for in this study. (While these are suggestions for future study, we can use the current study findings to inform policy development.)

Implications for Transportation and Policy

Upon passage of the Intermodal Surface Transportation Efficiency Act, both the number of projects implemented and the funding obligated to bicycle and pedestrian improvements increased dramatically and continued to build under subsequent Transportation Equity Act for the 21st Century legislation. Policy makers have already begun to debate the content of the next generation of federal transportation legislation that will fund US states and counties after 2009. This critical juncture presents the opportunity to expand the use of transportation funding for activities that promote public health, by supporting state and local community efforts to use federal funding for projects that will make routine walking and bicycling easier and more viable forms of transportation, particularly in metropolitan areas.

With the Intermodal Surface Transportation Efficiency Act, Congress showed support for regional planning and implementation, shifting more responsibility for transportation planning and provision in urban areas from the state departments of transportation to Metropolitan Planning Organizations, which are local regional planning agencies (50). Many Metropolitan Planning Organizations have qualities and capacities (i.e., staff competence and credibility, leadership, level of diverse public involvement) that contribute to their success in planning and implementing projects (50), potentially increasing the likelihood of bicycle and pedestrian project implementation in urban (vs. non-urban) areas. However, regional

transportation investment decisions are often based on cost–benefit considerations that subsequently shape local environments (51). Metropolitan Planning Organizations and local governments likely have many competing transportation projects and local decision makers might decide it is in a region's interest to devote less to bicycling and pedestrian improvements and more to other areas (e.g., transit or roadway improvements), given local transportation needs and circumstances (e.g., congestion, air quality). Potentially, counties not covered by a Metropolitan Planning Organization, or those counties with limited economic resources, may lack the institutional capacity or staffing support necessary to plan and implement bicycle and pedestrian projects or even the matching funds required to access federal funds via these transportation programs.

To address the documented social and economic disparities in implementation of programs and facilities that support bicycling and walking, a targeted strategy to provide improved bicycle and pedestrian planning and implementation capacity at the local, community, or regional planning level may be needed in areas that have been less successful in implementing projects that support travel-related walking and bicycling (i.e., low education, persistent poverty areas). Sharing of best practices for promoting travel-related walking and bicycling solutions among regional planning agencies may assist in increasing planning and implementation capacity for bicycle and pedestrian projects. Streamlining application processes and lowering match requirements may also be necessary policy strategies to promote investments in underserved areas (i.e., areas lacking prior investment in bicycle and pedestrian transportation infrastructure).

As the US Department of Transportation works to meet their two goals of increasing the proportion of non-motorized trips while simultaneously increasing safety, Federal Highway Administration guidance to states and local planning agencies may need to promote and monitor implementation of local investments in bicycling and pedestrian infrastructure. In those counties with bicycle and pedestrian projects, the proportion of a county's employed residents that walked, bicycled, or took public transit to work was positively associated with per capita funding for bicycling and pedestrian improvements, the number of projects implemented, and the number

of years that projects were undertaken. Promoting bicycling and pedestrian investments may benefit from a strategy that explicitly recognizes the important role transportation plays in promoting public health (e.g., improved air quality, promoting physical activity). For example, transportation cost–benefit modeling might be expanded through the use of new public health cost–benefit models to explicitly address a project's potential public health impacts, and public health costs could be directly imputed in a cost–benefit analysis, thus ensuring that public health considerations are weighed against other factors (e.g., economic productivity from expanded roadway size). Research into the applicability of expanding transportation cost–benefit models in this way should be considered.

A second step will entail improving data tracking and monitoring systems for bicycle and pedestrian improvements. Improving data access will require making these data more readily available to researchers, planners, and policy makers and ensuring their timely availability at critical points in decision-making processes at national levels and as planners and the public are making decisions about local project and funding priorities. Improved data access will allow for ongoing, transparent assessments of how state, regional, and local governments allocate and spend federal transportation dollars to support the needs of both motorized and non-motorized forms of transportation. The ability to link data on transportation investments with local transportation mode, public health, and safety data (e.g., pedestrian injury) will enable more definitive research and improve our ability to monitor progress.

CONCLUSIONS

From 1992 to 2004, thousands of bicycle- and pedestrian-focused projects were undertaken in the United States through multiple federal funding programs. Significant opportunities to use federal transportation funding in support of active living investments exist. However, disparities in implementation and project-related outcomes were observed according to social and economic indicators, as well as population size and region. The authors conclude that three key policy factors are vital to expanding the

use of federal transportation funding for bicycle and pedestrian activities that promote public health: Improved data tracking, more explicit linkages between transportation projects and public health, and promoting better implementation in underserved communities are seen as critical steps for improving public health outcomes.

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REFERENCES

1. Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease. *J Appl Physiol*. 2005;99(3):1193–204.
2. US Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion; 1996.
3. Chowdhury PP, Balluz L, Murphy W, Wen XJ, Zhong Y, Okoro C, *et al.* Surveillance of certain health behaviors among states and selected local areas – United States, 2005. *MMWR Surveill Summ*. 2007;56(4):1–160.
4. Simpson ME, Serdula M, Galuska DA, Gillespie C, Donehoo R, Macera C, *et al.* Walking trends among US adults: the behavioral risk factor surveillance system, 1987–2000. *Am J Prev Med*. 2003;25(2):95–100.
5. Pikora T, Giles-Corti B, Bull F, Jamrozik K, Donovan R. Developing a framework for assessment of the environmental determinants of walking and cycling. *Soc Sci Med*. 2003;56(8):1693–703.
6. Chakravarthy MV, Joyner MJ, Booth FW. An obligation for primary care physicians to prescribe physical activity to sedentary patients to reduce the risk of chronic health conditions. *Mayo Clinic Proc*. 2002;77(2):165–73.
7. Wen LM, Rissel C. Inverse associations between cycling to work, public transport, and overweight and obesity: findings from a population based study in Australia. *Prev Med*. 2008;46(1):29–32.
8. Lindstrom M. Means of transportation to work and overweight and obesity: a population-based study in southern Sweden. *Prev Med*. 2008;46(1):22–8.
9. Wagner A, Simon C, Ducimetiere P, Montaye M, Bongard V, Yarnell J, *et al.* Leisure-time physical activity and regular walking or cycling to work are associated with adiposity and 5 y weight gain in middle-aged

men: the PRIME Study. *Int J Obes Relat Metab Disord*. 2001;25(7): 940–8.
10. Hamer M, Chida Y. Active commuting and cardiovascular risk: a meta-analytic review. *Prev Med*. 2008;46(1):9–13.
11. Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Arch Intern Med*. 2000;160(11):1621–8.
12. Federal Highway Administration (FHWA). *National Bicycling and Walking Study: Ten Year Status Report, October 2004*. 2004, Available at http://www.fhwa.dot.gov/environment/bikeped/study/index.htm, accessed 8 April 2008.
13. Pucher J, Komanoff C, Schimek P. Bicycling renaissance in North America? Recent trends and alternative policies to promote bicycling. *Transp Res Part A: Policy Pract*. 1999;33(7–8):625–54.
14. Reschovsky C. *Journey to Work: 2000. Census 2000 Brief (2004)*. Available at http://www.census.gov/population/www/cen2000/briefs.html, (C2KBR-33), accessed 10 September 2007.
15. McGuckin N, Srinivasan N. *Journey to Work Trends in the United States and its Major Metropolitan Areas 1960–2000. Report No. FHWA-EP-03–058*. Washington, DC: US Department of Transportation and Federal Highway Administration; 2003.
16. McDonald NC. Active transportation to school: trends among US schoolchildren, 1969–2001. *Am J Prev Med*. 2007;32(6):509–16.
17. Pucher J, Dijkstra L. Promoting safe walking and cycling to improve public health: lessons from the Netherlands and Germany. *Am J Public Health*. 2003;93(9):1509–16.
18. Humpel N, Owen N, Leslie E. Environmental factors associated with adults' participation in physical activity: a review. *Am J Prev Med*. 2002;22(3):188–99.
19. Transportation Research Board. *Does the Built Environment Influence Physical Activity? Examining the Evidence. Special Report No. 282*. Washington, DC: Transportation Research Board, Institute of Medicine of the National Academies; 2005.
20. Research and Innovative Technology Administration (RITA), US Department of Transportation (USDOT). *Intermodal Surface Transportation Efficiency Act of 1991* Available at http://ntl.bts.gov/DOCS/istea.html, accessed 15 September 2008.
21. Federal Highway Administration (FHWA). *Transportation Equity Act for the 21st Century*. Available at http://www.fhwa.dot.gov/tea21/index.htm, accessed 15 September 2008.
22. Federal Highway Administration (FHWA). *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*. Available at

http://www.fhwa.dot.gov/safetealu/index.htm, accessed 15 September 2008.
23. Federal Highway Administration (FHWA). *FHWA Guidance – Bicycle and Pedestrian Provisions of Federal Transportation Legislation*. 2007, Available at http://www.fhwa.dot.gov/environment/bikeped/bp-guid.htm, accessed 14 August 2008.
24. Federal Highway Administration (FHWA). *Fact Sheet: Surface Transportation Program*. Available at http://www.fhwa.dot.gov/Tea21/factsheets/stp.htm, accessed 15 September 2008.
25. Federal Highway Administration (FHWA). *Transportation Enhancements*. Available at http://www.fhwa.dot.gov/environment/te/, accessed 15 September 2008.
26. Federal Highway Administration (FHWA). *Congestion Mitigation and Air Quality (CMAQ) Improvement Program*. Available at http://www.fhwa.dot.gov/environment/cmaqpgs/, accessed 15 September 2008.
27. Federal Highway Administration (FHWA). *Recreational Trails Program*. Available at http://www.fhwa.dot.gov/environment/rectrails/, accessed 15 September 2008.
28. Federal Highway Administration (FHWA). *Transportation, Community, and System Preservation Program*. Available at http://www.fhwa.dot.gov/tcsp/, accessed 15 September 2008.
29. Federal Highway Administration (FHWA). *High Priority Projects Program*. Available at http://www.fhwa.dot.gov/safetealu/factsheets/highpriproj.htm, accessed 15 September 2008.
30. Surface Transportation Policy Partnership. *The Transportation Funding Loophole: How States Underfund Federal Programs*. 2002, Available at http://www.transact.org/library/oblimit.asp, accessed 8 April 2008.
31. McDowell BD. *Improving Regional Transportation Decisions: MPOs and Certification*. Washington, DC: The Brookings Institution Center on Urban and Metropolitan Policy; 1999.
32. Katz B, Puentes R, Bernstein S. *TEA-21 Reauthorization: Getting Transportation Right for Metropolitan America*. Washington, DC: The Brookings Institution; 2003.
33. Lee C, Moudon AV. Physical activity and environment research in the health field: implications for urban and transportation planning practice and research. *J Plann Lit*. 2004;19(2):147–81.
34. Economic Research Service (ERS), US Department of Agriculture (USDA). *Briefing Rooms, Measuring Rurality: Urban Influence Codes*. Available at http://www.ers.usda.gov/Briefing/rurality/UrbanInf/, accessed 15 September 2008.

35. Economic Research Service (ERS), US Department of Agriculture (USDA). *Briefing Rooms, Measuring Rurality: 2004 County Typology Codes*. Available at http://www.ers.usda.gov/Briefing/Rurality/Typology/, accessed 15 September 2008.
36. CensusCD 2000 long form SF3. *National Version Release 2.2 (DVD-ROM)*. East Brunswick, NJ: GeoLytics; 2005, (1 DVD-ROM 4 3/4 in.).
37. US Counties Generalized. *ESRI data and maps [CD-ROM] Redlands (CA)*. Redlands, CA: Environmental Systems Research Institute (ESRI); 2004, (CD-ROMs 4 3/4 in.).
38. Besser LM, Dannenberg AL. Walking to public transit: steps to help meet physical activity recommendations. *Am J Prev Med*. 2005;29(4): 273–80.
39. SAS Institute Inc. SAS/STAT:[Internet]. Cary, NC. 2006. (cited 2008 Oct 31). Available at http://www.sas.com/technologies/analytics/statistics/stat/index.html.
40. Bryk AS, Raudenbush SW. *Hierarchical Linear Models: Applications and Data Analysis Methods*. Newbury Park, CA: Sage Publications; 1992.
41. US Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health*, 2nd edition. Washington, DC: US Government Printing Office; 2000.
42. Pedestrian and Bicycle Information Center. *What is the Economic Cost of Crashes Involving Bicyclists and Pedestrians?* Available at http://www.bicyclinginfo.org/faqs/answer.cfm?id=42, accessed 18 September 2008.
43. Colditz GA. Economic costs of obesity and inactivity. *Med Sci Sports Exerc*. 1999;31(11 Suppl):S663–7.
44. American Diabetes Association. Economic costs of diabetes in the US in 2007. *Diabet Care*. 2008;31(3):596–615.
45. Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, *et al*. Heart disease and stroke statistics – 2008 update: a report from the American heart association statistics committee and stroke statistics subcommittee. *Circulation*. 2008;117(4):e25–146.
46. Diez Roux AV, Merkin SS, Arnett D, Chambless L, Massing M, Nieto FJ, *et al*. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*. 2001;345(2):99–106.
47. Wang MC, Kim S, Gonzalez AA, MacLeod KE, Winkleby MA. Socioeconomic and food-related physical characteristics of the neighbourhood environment are associated with body mass index. *J Epidemiol Community Health*. 2007;61(6):491–8.
48. Thunderhead Alliance. *Benchmarking Report 2007: Bicycling and Walking in the US*. Washington, DC: Thunderhead Alliance; 2007.

49. Edwards RD. Public transit, obesity, and medical costs: assessing the magnitudes. *Prev Med*. 2008;46(1):14–21.
50. Goetz AR, Dempsey PS, Larson C. Metropolitan planning organizations: findings and recommendations for improving transportation planning. *Publius*. 2002;32(1):87–105.
51. Frank LD. Economic determinants of urban form: resulting trade-offs between active and sedentary forms of travel. *Am J Prev Med*. 2004;27(3 Suppl):146–53.