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The Built Environment and Utilitarian Walking in Small U.S. Towns

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INTRODUCTION

Rural-residing adults in the United States (U.S.) walk less than their urban counterparts, [1,2] yet little is known about the role of built environment features on this low prevalence of walking. In urban areas, neighborhood design and land use planning have been shown to affect travel mode choices, including walking and transit use.[3-10] Walkable cities and suburbs are characterized by medium-to-high population density, a mix of land uses, high connectivity, and presence of pedestrian infrastructure.[10] The distance between one's origin and destination (proximity) and the difficulty of arriving at one's destination (connectivity) are two major factors influencing the use of walking versus motorized transport in the urban setting. [11,12]

Compared to urban locations, rural towns have smaller residential and commercial cores defining geographic concentrations of population and employment. However, a large

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Conflict of Interest Statement
The authors declare there is no conflict of interest.

number of these U.S. towns are located within micropolitan counties that contain at least one cluster of 10,000-49,999 persons, and these locations comprise 10% of the U.S. population.[13] The built environment in such settings is likely to contain aggregations of residences in proximity to employment and retail locations in which daily life occurs. In other words, these towns may contain areas that resemble urban walkable neighborhoods with potential support for walking.

Walking is the most frequent type of physical activity reported by U.S. adults.[14,15] It is associated with an array of benefits, including greater longevity[16, 17, 18] and reduced chronic disease.[16,17,19-22] It is inexpensive and accessible and is more likely to be sustained than other types of physical activity. Among the types of walking, utilitarian walking – walking to routine destinations – has been identified as a central element underpinning sustainable lifestyle changes in studies examining urban residents[10,23] and may be an effective means of achieving recommended physical activity levels when incorporated into one's daily routine.[24-26]

We identified self-reported and objective built environment correlates of walking among adult residents of small rural towns and hypothesized that self-reported (e.g., proximity to retail locations, safety, attractiveness, convenience, and comfort) and objective measures (e.g., type of land use, open space, and transportation infrastructure) would be independently associated with utilitarian walking after accounting for socio-demographic and behavioral characteristics.

METHODS

Sample and Subjects

Telephone survey data were collected during 2011-2012 from adult residents of nine small towns located in three diverse locations, Washington State, Texas, and the Northeast (New Hampshire and New York) (Appendix A). Four criteria were used to select the towns: (1) sufficient population (≥ 10,000) to contain businesses and services needed for daily living; (2) presence of residential areas located in proximity to businesses and services that could allow walking to/from routine activities; (3) diversity of socioeconomic levels within each town; and (4) availability of geographic information systems (GIS) data characterizing the built environment of the town.

We used a spatial sampling strategy that included parcels within census blocks that together contained 80% of the town population.[27] We created a list of addresses from these parcels, from which reverse telephone look-up yielded 21,498 land-line phone numbers; of these, 10,010 were invalid (e.g., disconnected numbers, business numbers), which left 11,488 phone numbers for recruitment.

Eligibility criteria for respondents included: age 18 years or older; residence at the address for at least one year; and ability to walk without special equipment for at least five minutes. Potential respondents received an advance letter and a maximum of nine call-backs. The survey required roughly 20 minutes for completion and was available in English and Spanish. A total of 2,152 surveys (217 to 303 per town) were completed with a response rate

of 18.8% of the potentially reachable numbers. All respondents provided informed consent and received $10 for participating. Procedures and materials were approved by the Institutional Review Boards at the University of Washington, Dartmouth College, and Texas A&M University.

Data Collection

Survey (socio-demographics, walking behaviors, and self-reported environment)—Content included questions from existing surveys from peer-reviewed research including the International Physical Activity Questionnaire, [28] the Walkable and Bikable Communities Project[29] and the Neighborhood Environment Walkability Scale.[30] Questions were refined through iterative pilot testing, and covered the following domains (Appendix B demographics (age, sex, marital status, household composition); socioeconomic status (household income, educational attainment, employment); race and ethnicity (non-Hispanic white, Hispanic, African American/Black, other); health status (height and weight from which we calculated body mass index [BMI], difficulty in walking, overall health perception); perceived barriers and motivators to walking (presence of crosswalks and pedestrian light signals, unattended dogs, traffic speed, sidewalks, destinations such as coffee shops, trails/paths); behaviors (screen time, frequency and duration of walking for recreational purposes; non-walking physical activity); and neighborhood perceptions (presence of sidewalks, shade, lighting and other safety conditions). Minutes per week engaged in utilitarian walking were calculated from responses to items querying how many times per month respondents walked from their homes to specific destinations and how many minutes these walking trips required. The survey is included as Appendix C.

GIS Data (objective environment)—GIS data were obtained for each town from national, regional and local governments; proprietary data providers; tourism and recreation agencies; aerial photos; on-line maps as well as local knowledge (e.g., direct observation of towns, discussion with local residents, and phone calls to confirm types of retail stores). Detailed protocols and definitions were created to ensure valid and consistent GIS measures across all nine towns. The following domains were covered: generalized land use; residential density; employment density; destination land use; transportation infrastructure; economic environment; local accessibility; and natural environment (Appendix B). All buffer-based measures (e.g., street intersection density) were calculated as the area within a 1 km. street network around a respondent's home using the "sausage" buffer technique.[31] All proximity measures (e.g., distance to the closest park) were calculated as the street-network distance from a respondent's home to a given location up to 2 km. along the road network.

Data Analysis

We used two-level mixed-effect logistic regression models to identify significant predictors of utilitarian walking. Separate models were constructed for two utilitarian walking dependent variables: "any" versus "none; and "high" (≥ 150 minutes per week) versus "low" (< 150 minutes per week, including none). Multivariate modeling involved sequential steps: (1) construction of a "base model" incorporating survey-based socio-demographic and self-reported neighborhood measures that achieved a significance level of $p<0.05$; (2) selection

of the subset of specific variables within each GIS domain to be modeled together by adding each GIS variable one at a time to the base model; (3) adding all significant ($p<0.05$) GIS domain variables identified in step 2 to the base model; and (4) development of the "final model" that retained all significant variables identified in step 3. Overall model fit was adequate in both final models, and the effect of town-level clustering, which was significant in the base models, and therefore accounted for by using the mixed-effect model, was not significant in the final models. Statistical analyses were conducted using STATA version 12.0.

RESULTS

Across all nine towns, 73% of participants engaged in any utilitarian walking and 22% reported walking for ≥150 minutes per week. Table 1 shows unadjusted analyses comparing the "any" to the "no" utilitarian walking group and the "low" to the "high" one. Socio-demographic characteristics associated with higher odds of utilitarian walking in both analyses included: younger age ($p<0.001$, both models); male sex ($p<0.001$, $p=0.049$, respectively); non-white race ($p=0.003$, $p=0.011$); non-obese BMI ($p=0.040$, $p<0.001$); residence in non-single family housing ($p=0.015$, $p<0.001$); fewer hours of screen time ($p<0.001$, $p=0.008$); reporting any non-utilitarian recreational walking ($p<0.001$, both); and reporting any non-walking physical activity ($p<0.001$ for both). Perceived environmental characteristics that were associated with increased odds of utilitarian walking in both analyses included: presence of crosswalks and light signals ($p<0.001$ for both); slow traffic speeds ($p=0.010$, $p=0.045$); and availability of a coffee "place" ($p<0.001$ for both), trail/path ($p<0.001$, both), or park/natural recreational area ($p<0.001$ for both) in the neighborhood. GIS-derived environmental measures that were positively associated with utilitarian walking in both analyses included: presence of manufacturing land use ($p<0.001$, both); absence of resource production/extraction land use ($p<0.001$ for both); presence of a post office; ($p<0.001$, both); close proximity to a school in the neighborhood ($p<0.001$, both); and presence of an intercity transit stop ($p<0.001$, both).

Tables 2 and 3 present findings from the two multivariate analyses of walking outcomes (any versus none and high versus low). Socio-demographic and lifestyle characteristics significantly associated utilitarian walking in both models included: higher income level (Odds Ratio and 95% Confidence Interval .92 [.85, .98] and .83 [.77, .89], respectively); and reporting any non-utilitarian recreational walking (1.39 [1.29, 1.50]; 1.58 [1.45, 1.71]). In the model of any versus no utilitarian walking, additional socio-demographic measures that were significantly associated with utilitarian walking included: female sex (.55 [.42, .71]); and increasing age (.98 [.97, .99]). In the any versus no utilitarian walking model the lifestyle characteristics that were significantly associated with utilitarian walking included: weekly hours of screen time (.90 [.79, 1.04] and lack of time (1.54 [1.18, 2.01]). In the high versus low walking model, additional socio-demographic measures included: BMI of 30 or more (.43 [.29, .64]); and reporting any non-walking physical activity (1.11 [1.04, 1.18]).

Self-reported environmental characteristics significantly associated with higher odds of utilitarian walking in both multivariate models included: presence of crosswalks and light signals (1.65 [1.25, 2.18] and 1.59 [1.17, 2.17]) and availability of a park/natural

recreational area in the neighborhood (1.87 [1.42, 2.47] and 1.50 [1.07, 2.10]). In the any versus no walking model an additional perceived environmental measure significantly associated with higher odds of any utilitarian walking included: presence of trails/paths/tracks (1.88 [1.44, 2.46]). In the high versus low walking model, additional perceived environmental measures included: unattended dogs (1.88 [1.32, 2.68]); slow traffic speed (1.54 [1.10, 2.15]); and presence of a coffee place (1.48 [1.09, 2.01]).

Only three out of the eight objective environmental (GIS) domains included at least one significant variable in either of the final models: generalized land use; destination land use; and transportation infrastructure. The only objectively measured factor associated with higher odds of utilitarian walking in both the any versus none and the high versus low analyses was presence of manufacturing land use (1.43[1.02, 2.00]; 1.64 [1.23, 2.21]). Also within the land use domain, presence of resource production/extraction was significantly associated with higher odds of walking in the high versus low model (. 65 [.48, .87]). For the destination land use domain, distance to the closest school was significantly associated with utilitarian walking in the any versus none model (see Table 3 for ORS and CIs), while presence of a post office was significant in the high versus low model (1.64 [1.39, 2.64]). For the transportation infrastructure domain, presence of intercity transit stops was significantly associated with utilitarian walking in the any versus no walking model (2.40 [1.23, 4.69]).

DISCUSSION

This study is the first to examine the influence of the built environment on utilitarian walking among residents of small towns in a range of U.S. rural locations. The majority of adults in our sample engaged in utilitarian walking to some degree, yet only 22% reported doing so for 150 minutes per week or longer. This proportion is lower than the estimated 37% of the U.S. population who were classified as regular walkers[32] as defined by the public health recommendation of engaging in at least 150 minutes per week of moderate-intensity physical activity, such as walking[33] and about half of the proportion estimated for those living in an urban area who responded to a survey with similar questions.[29] This low amount of regular utilitarian walking may reflect a greater reliance on automobiles in small towns than in larger urban areas.[34] Yet much like urban neighborhoods, these towns do contain environmental features that are conducive to utilitarian walking, such as crosswalks and pedestrian signals, and they also contain destination locations, such as parks and trails, coffee shops and post offices. This suggests that small towns could leverage their existing infrastructure to increase the amount of utilitarian walking. Moreover, research in urban settings shows that the presence of combinations of built environment features, such as small street blocks and multiple routine destinations (e.g., grocery stores, restaurants, banks, and other stores) appear to have a greater impact in inducing walking that the presence of isolated features.[29] These types of combinations may be especially important in rural towns where baseline amounts of utilitarian walking are low.

We unexpectedly identified manufacturing as a land use that was positively associated with utilitarian walking. To our knowledge, manufacturing has not been related to greater walking in previous research. Presence of manufacturing typically is considered a deterrent

to walking, as are resource production and extraction land uses (which were negatively related to utilitarian walking in our study). Further examination of public data reveals that manufacturing in the study towns consisted primarily of small-scale production (e.g., wine making, furniture production) concentrated in relatively small parcels that, contrary to typical heavy industry uses, were located near retail, recreational, and residential locations, as illustrated in Figure 1 which depicts a partial view of one study town. (Nearly one-third of the respondents included in this figure reported a high amount of utilitarian walking, whereas less than a quarter of the respondents from the entire sample reported this level of walking.) This suggests that in small rural towns, manufacturing land uses were a proxy for small employment centers that might have the added benefit of increased population-level utilitarian and recreational walking.

Recreational walking was strongly associated with utilitarian walking in both models. While those who engage in any walking likely do so across multiple contexts, research is needed to better understand if the relationship between recreational and utilitarian walking is additive or substitutive (for example, if greater utilitarian walking leads to greater or less recreational walking or vice versa). Local governments may face major fiscal and regulatory barriers to altering their “main street” retail hubs for the purpose of increasing utilitarian walking. Yet these governments, through parks and recreation departments, may be able to directly enhance walkability in and around municipal parks and trails. If increased recreational walking leads to increased utilitarian walking, such enhancements to parks and trails might have the added benefit of increasing both behaviors. Another benefit to local municipalities from increased utilitarian walking is the potential of reduced pollution, congestion, and needs for parking.

LIMITATIONS

Although the sampling frame is not representative of all U.S. small towns in rural locations, it included towns from three distinct geographic regions with a range of socio-demographic characteristics and a population base large enough to support utilitarian walking. Response rates to the land line-based telephone survey were low and respondents might have different walking habits than non-respondents. However, alternatives, such as door-to-door or cell-phone-based approaches, were prohibitively expensive. Also, the proportion of respondents who were younger, male or Latino was lower than their underlying distribution in the study towns. Because ascertainment of walking relied on self-report as opposed to objective measurement, respondents may have over-reported their walking behaviors. However, we have no reason to believe that possible over-reporting would have varied by characteristics of the built environment. Also, as with any observational study, bias from unmeasured confounding may exist. To minimize this possibility, existing literature was used to guide the collection of data on a range of *a priori* control variables. Moreover, we accounted for the seasonality of walking by conducting the surveys in each location during months when the temperature would be most conducive to walking (e.g., early spring in Texas and later in the season in Washington and the Northeast).

CONCLUSION

For many persons, walking is a critical component of physical activity, so even small increases may have significant health benefit at the population level. Our findings suggest that small towns can support utilitarian walking and that environmental factors known to be related to walking in urban environments, such as the presence of crosswalks and pedestrian signals, are also significant in small towns. Moreover, small-scale manufacturing land use in these towns may actually promote utilitarian walking. Increased attention to the small town environment could lead to increases in walking, which could improve the health status of residents of rural communities in the U.S.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Highlights

- Nearly 10% of U.S. adults live in small rural towns.
- Small rural towns can support utilitarian walking.
- Environmental factors related to walking in small towns mirror those in urban areas.
- Light manufacturing land use was positively associated with walking in small towns.

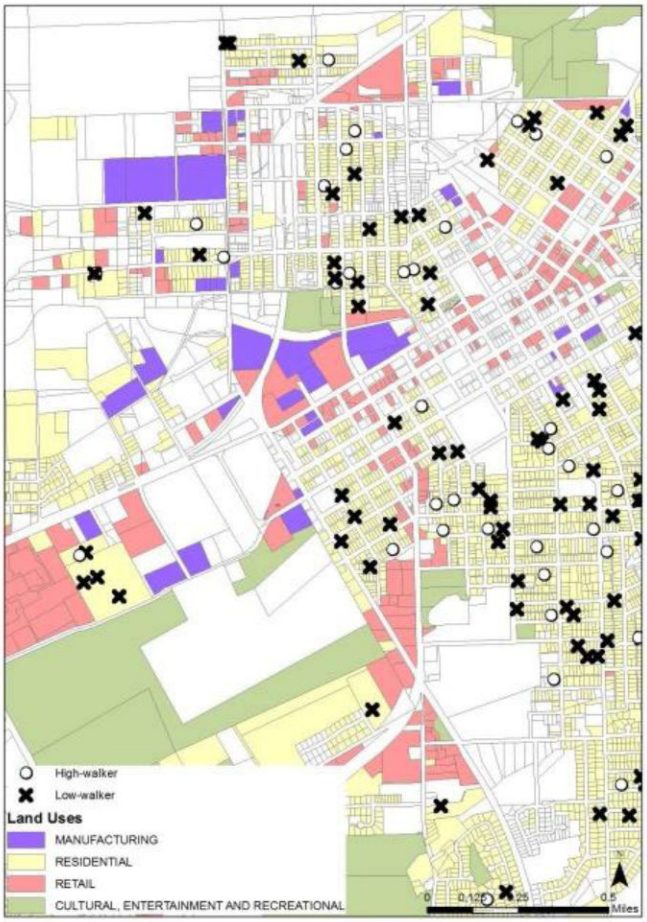

Figure 1.

Depiction of manufacturing, recreation, entertainment and retail locations, and “high” versus “low” utilitarian walking residential location among adults in a rural town.

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Table 1

Unadjusted relationship between selected study variables and utilitarian walking among adults in nine small, rural towns, 2010-2011

Characteristic (no. with missing data)		Walking			Walking		
		None(576)	Any (1,576)	p-value	Low (1,689)	High (463)	p-value
	Socio-demographics						
Mean age (missing 7)		63.2	55.6	<0.001	58.4	54.7	<0.001
Sex (missing 4)							
	% Male	21.6	78.5		76.3	23.7	
	% Female	30.0	70.0	<0.001	79.9	20.1	0.049
Household income (missing 136)							
	% <=$25,000	25.3	74.7		68.1	31.9	
	% $25,001-$50,000	27.5	72.5		81.4	18.6	
	% $50,001-$75,000	24.4	75.6	0.110	80.0	20.0	<0.001
	% $75,001-$100,000	24.9	75.1		81.3	18.7	
	% >$100,000	28.2	71.8		82.8	17.2	
Education (missing 7)							
	% < High School	22.7	77.3		71.4	28.6	
	% High School or GED	31.5	68.5		79.3	20.7	
	% Some College/Associate Deg.	26.1	73.9	0.076	81.1	18.9	0.075
	% College Grad.	26.9	73.1		79.0	21.0	
	% Graduate School	23.8	76.2		76.2	23.8	
Ethnicity (missing 13)							
	% Latino	20.7	79.3	0.029	74.5	25.6	0.113
	% Non-Latino	27.5	72.5		79.0	21.0	
Race (missing 4)							
	% Non-White	20.3	79.7	0.003	73.4	26.7	0.011
	% White	28.0	72.0		79.5	20.5	
BMI (missing 131)							

Characteristic (no. with missing data)		Walking			Walking		
		None(576)	Any (1,576)	p-value	Low (1,689)	High (463)	p-value
	%<18	38.1	61.9		71.4	28.6	
	%18 to 25	25.6	74.4	0.040	75.1	24.9	<0.001
	% >25 to 30	24.2	75.8		77.3	22.7	
	% >30	30.6	69.4		86.2	13.8	
Marital status (missing 14)							
	% Unmarried	27.3	72.7	0.698	74.5	25.5	0.001
	% Married	26.5	73.5		80.6	19.4	
Mean number of children in household (missing 7)		0.36	0.61	<0.001	0.53	0.62	0.097
Employment (missing 4)							
	% Unemployed	32.8	67.2		79.6	20.4	
	%Employed	22.7	77.3	<0.001	77.7	22.3	0.293
Housing type (missing 5)							
	% Not Single-Family Home	21.2	78.8	0.015	69.1	30.9	<0.001
	% Single-Family Home	27.7	72.3		80.1	19.9	
	Lifestyle Characteristics						
Mean weekly hours of screen time (missing 46)		19.0	16.0	<0.001	17.2	15.3	0.008
Mean number of meals away from home each week (missing 33)		2.5	2.4	0.267	2.5	2.3	0.225
Recreational walking (missing 4)							
	% without any weekly hrs. of rec. walking	55.9	44.1	<0.001	92.5	7.5	<0.001
	% with weekly hrs. of rec. walking	23.6	76.4		77.0	23.0	
Non-Walking physical activity (missing 36)							
	% without any days per weekof≥30 min. of non-walking physical activity (PA)	37.2	62.8	<0 001	87.8	12.2	<0 001
	% with days per week of ≥ 30 min. of non-walking PA	24.0	76.0		76.1	23.9	
Lack of time barrier to walking (missing 11)							
	% yes	21.1	78.9	<0.001	79.0	21.0	0.621

Characteristic (no. with missing data)		Walking			Walking		
		None(576)	Any (1,576)	p-value	Low (1,689)	High (463)	p-value
	% no	31.2	68.8		78.1	21.9	
Self-Reported Environmental Measures							
Crosswalks and pedestrian light signals to help walkers cross busy streets present (missing 20)							
	% disagree	37.7	62.3	<0.001	87.1	12.9	<0.001
	% agree	17.3	82.8		71.2	28.8	
Unattended dogs present (missing 13)							
	% agree	25.6	74.4	0.582	74.1	25.9	0.030
	% disagree	27.1	72.9		79.4	20.6	
Speed of traffic on nearby streets slow (missing 46)							
	% disagree	30.9	69.1	0.010	81.6	18.4	0.045
	% agree	25.2	74.8		77.5	22.6	
Coffee “place” within 20-min walk of home (missing 33)							
	% no	36.4	63.6	<0.001	87.0	13.0	<0.001
	% yes	18.6	81.5		71.0	29.0	
Trail or path within 20-min walk of home (missing 31)							
	% no	43.2	56.8	<0.001	85.2	14.8	<0.001
	% yes	18.4	81.6		75.0	25.0	
Park or natural recreational area within 20-minute walk of home (missing 22)							
	% no	44.5	55.5	<0.001	88.2	11.8	<0.001
	% yes	18.2	81.8		73.8	26.3	
Objective Environmental Measures							
Generalized Land Use: manufacturing (missing 21)							
	% 1 or more	17.6	82.4	<0.001	70.9	29.1	<0.001
	none	34.7	65.3		85.5	14.5	
Generalized Land Use: resource production and extraction (missing 21)							
	% 1 or more	33.3	66.7	<0.001	83.8	16.2	<0.001

Characteristic (no. with missing data)		Walking None(576)	Walking Any (1,576)	p-value	Walking Low (1,689)	Walking High (463)	p-value
	% none	19.4	80.6		73.0	27.0	
Destination: post office (missing 21)							
	% 1 or more	12.8	87.2	<0.001	64.7	35.4	<0.001
	% none	30.2	69.8		82.2	17.8	
Shortest distance to school (missing 0)							
	% < 500 m	17.1	82.9	<0.001	74.3	25.7	<0.001
	% ≥ 500 m	32.7	67.3		81.1	19.0	
Presence of intercity transit stops within buffer (missing 21)							
	% no	28.1	71.9	<0.001	79.9	20.1	<0.001
	% yes	11.7	88.3		65.6	34.4	

Table 2

Adjusted relationship between selected characteristics and “any” versus “no” utilitarian walking among adults in nine small, rural towns, 2010-2011.

Variables			Odds Ratio	95% Conf.Interval	
				Lower	Upper
Socio-demographics and Lifestyle Characteristics					
Sex (female, male-ref.)			0.55	0.42	0.71
Age (continuous)			0.98	0.97	0.99
Income (9-cat., ordinal)			0.92	0.85	0.98
Weekly hours of screen time (logged with lower end of 1)			0.90	0.79	1.04
Weekly hours of recreational walking (7-cat., ordinal)			1.39	1.29	1.50
Does [item] keep you from walking?		Lack of time	1.54	1.18	2.01
Self-Reported Environmental Measures					
By neighborhood, we mean the area within a 20-minute walk from your home. Do you agree or disagree with the following statements?		There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.	1.65	1.25	2.18
Is there [destination] within a 20-miunte walk from your home?		a trail, path, or track	1.88	1.44	2.46
		a park or natural recreation area	1.87	1.42	2.47
Objective Environmental Measures					
Generalized Land Use	Presence of manufacturing land use within buffer		1.43	1.02	2.00
	Presence of resource production and extraction land use within buffer		0.65	0.48	0.87
Destination	Shortest distance to the closest school (meters)	0 – 500	(Reference Group)		
		500 – 1,000	0.66	0.47	0.93
		1,001 – 2,000	0.61	0.43	0.86
		2,000+	0.48	0.32	0.73
Transportation	Presence of intercity transit stops within buffer		2.40	1.23	4.69

Table 3

Adjusted relationship between selected characteristics and “high” versus “low” utilitarian walking among adults in nine small, rural towns, 2010-2011.

Variables		Odds Ratio	95% Conf.Interval	
			Lower	Upper
Socio-demographics and Lifestyle Characteristics				
Sex (female, male-ref.)		0.78	0.59	1.03
Age (continuous)		0.99	0.99	1.00
BMI	25.0 or less	*(Reference Group)*		
	25.1 – 300.0	0.95	0.70	1.28
	30.1 or higher	0.43	0.29	0.64
Income (9-cat., ordinal)		0.83	0.77	0.89
Days/week with 30+ min. of PA excluding walking		1.11	1.04	1.18
Weekly hours of recreational walking (7-cat., ordinal)		1.58	1.45	1.71
Self-Reported Environmental Measures				
By neighborhood, we mean the area within a 20-minute walk from your home. Do you agree or disagree with the following statements?	There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.	1.59	1.17	2.17
	Unattended dogs are a problem in my neighborhood.	1.88	1.32	2.68
	The speed of traffic on most nearby streets is usually slow.	1.54	1.10	2.15
Is there [destination] within a 20-minute walk from your home?	a coffee place	1.48	1.09	2.01
	a park or natural recreation area	1.50	1.07	2.10
Objective Environmental Measures				
Generalized Land Use	Presence of manufacturing land use within buffer	1.64	1.23	2.21
Destination	Presence of post offices within buffer	1.92	1.39	2.64