ORIGINAL RESEARCH

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The Impact of the Built Environment on Walking as a Leisure-Time Activity Along the U.S./Mexico Border

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Background: This study examined if the environmental variables related to transportation walking were related to leisure-time walking. *Methods*: The sample ($N = 452$) was 71% female, 79% Hispanic, age 42 ± 17 y, and moderately acculturated. The data was analyzed with multiple stepwise regression. *Results*: For the entire sample, total time spent walking was related to higher socioeconomic status (SES) ($P = 0.02$; $R^2 = 0.06$), walking frequency was related to fewer barriers ($P = 0.03$; $R^2 = 0.07$), and walking duration was related to higher SES ($P = 0.02$), better health ($P = 0.40$), fewer barriers ($P = 0.02$), and living in a residential area ($P = 0.04$; $R^2 = 0.08$). Among regular walkers, total time spent walking was related to older age ($P = 0.03$) and fewer physical activity facilities ($P = 0.04$; $R^2 = 0.11$). Walking frequency was related to older age ($P = 0.02$), fewer facilities ($P = 0.04$), and living in a commercial neighborhood ($P = 0.02$; $R^2 = 0.11$). *Conclusions*: Most of the variables that influence transportation walking were not related to leisure-time walking. Land use had differential impacts on walking depending on the sample examined.

Key Words: physical activity, geocoding, transportation, Hispanic

Identifying the factors which influence physical activity has become a major public health priority. Sedentary behavior contributes to at least 300,000 preventable deaths each year and it is estimated that between 32% and 35% of deaths in the US as the result of coronary heart disease, colon cancer, and diabetes could be prevented by regular physical activity.[1, 2] Despite these unequivocal health benefits, almost one third of US adults get little or no exercise and almost 75% do not meet the recommended guidelines for physical activity.[3]

Researchers have traditionally examined numerous types of individual and social-level variables that could influence physical activity including demographics (age, gender, income), psychological/cognitive factors (barriers, attitudes, self-efficacy), and behavioral attributes and skills (activity history, problem solving).[4, 5] Researchers have now begun to examine the impact of the environment on physical activity, however. The first studies examined aspects of the environment such as aesthetics (presence of hills, pleasantness of neighborhood), safety, and accessibility

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of facilities (number of gyms, distance to walking/biking paths).[6-8] Even more recent research has included variables from the transportation literature, such as connectivity, density, and land use.[9-11]

Recent research has highlighted the different influences on walking as a leisure-time activity versus walking for transportation.[12] Walking for transportation is strongly influenced by density, connectivity, and land use[10] and it has also been found to be influenced by access to open space, perception of heavy traffic, and beach access (negative).[12] Walking as a leisure-time activity has been found to be influenced by aesthetics, weather, convenience (facilities and environment), coastal location, access to services, and trail length. Most of these variables, however, have only been examined in a handful of studies and more research is needed before definitive conclusions can be made as to which environmental correlates are important for walking for leisure versus walking for transportation.

The purpose of this project was to examine if the environmental variables that were related to walking for transportation were also related to walking as a leisure-time activity for adults living in El Paso, Texas, which is located on the US–Mexico border. Understanding the factors that influence walking is important since it is the most popular type of physical activity in the US and factors that might influence walking for one purpose (transportation) may or may not be related to walking for another purpose (physical activity).[12]

Multiple stepwise regression was used to examine the environmental variables after controlling for demographic, behavioral, and health-related variables. Various measures of walking for exercise (total time, frequency, and duration) served as the dependent variables in the regression analyses and the following independent variables were expected to be negatively related to walking for exercise: perceived barriers to physical activity, the number of children in the household, lower socioeconomic status (SES), and older age. In contrast, walking for exercise was expected to be positively related to the following independent variables: perceived benefits of walking, better overall health, more social support for walking, higher acculturation, more facilities in a neighborhood (walking/biking paths, gyms, schools, parks), less distance to facilities, and less change in neighborhood slope (elevation).

Method

Subjects

Individuals were selected throughout El Paso using random digit dial methodology. A list of phone numbers was generated by a national phone survey company (Survey Sampling Inc., Fairfield, CT) for use by local phone surveyors (Signius, El Paso, TX). These phone lists were designed to provide an even distribution of residential phone numbers across all the zip codes in El Paso County. A total of 5 attempts were made to contact each phone number on the list if it belonged to a residence. Each survey was given in either English or Spanish depending on the preference of the respondent. The community-wide health survey was administered to adults in February and March, 2001, before the beginning of the fourth year media campaign for the Paso del Norte Health Foundation's *Walk El Paso!* initiative. A total of 2000 calls were made for this survey, 500 of which were not residences or were disconnected numbers. From the remaining 1500 contacted residences, 534 were contacted and refused to complete the survey (36% refusal rate). Nine hundred sixty-six subjects agreed to complete the survey but only 953 had complete data for use in the analyses.

Approval for the study was obtained in writing from both the Paso del Norte Health Foundation and the Institutional Review Board for Human Subjects at the University of Texas at El Paso. Consent for the survey was obtained from each subject at the time of administration. Demographics for the subjects are shown in Table 1.

Table 1 Demographics for All Participants and Those Who Were Geocoded

	General health survey	Successfully geocoded participants	Nongeocoded participants
Number of surveys	953	452	501
BMI (kg/m^2)	26.6 ± 5.6	27.0 ± 5.5	26.3 ± 5.6
Age (y)	42 ± 17	44 ± 17	39 ± 16
Gender	71% female	70% female	71% female
Acculturation	3.08 ± 1.19	3.06 ± 1.23	3.10 ± 1.15
Ethnicity	79% Hispanic, 17% Caucasian	73% Hispanic, 29% Caucasian	79% Hispanic, 15% Caucasian
SES	27.5 ± 16.5	27.3 ± 17.0	27.7 ± 16.0

Note. For acculturation an average score of 1 reflected no acculturation and 5 reflected complete acculturation to the US. SES scores ranged from 8 (unskilled workers) to 66 (professionals and proprietors of large businesses).

Measures

Body-Mass Index (BMI). Subjects were asked to self-report their height and weight and BMI was calculated by dividing each subject's weight in kilograms by their height in meters squared (kg/m^2).[13]

Walking for Exercise. Subjects were asked "How often did you walk for exercise in the last month?" (frequency) and "On average how long did you walk each time you walked for exercise?" (duration). In addition, total minutes spent walking was calculated by multiplying frequency of walking by duration.[14]

Fruit and Vegetable Consumption. Subjects were asked how often they ate fruits or vegetables and responses, using a 6-point Likert-type scale, ranged from never (1) to several times a day (6).[14]

Overall Health. Subjects were asked to self-report their general health status. Answers ranged from excellent (1) to poor (5).[14]

Number of Diseases. Subjects were asked if they had been diagnosed with three different diseases (diabetes, high cholesterol, high blood pressure). For each disease, subjects who responded that they had been diagnosed received a score of 1 and those that had not been diagnosed received a score of 0. Total scores ranged from 0 (no reported diseases) to 3 (reported all diseases) on this measure.[14]

Social Support for Walking for Exercise. Each subject was asked if they walked with a friend or relative, a wife/husband/life partner, or a group of people. If they responded that they did walk with that person/group then they received a score of 1, if not they received a score of 0. The scores to each of the 3 items were then summed for a total score ranging from 0 to 3.[15]

Acculturation. Acculturation in this study reflected how people of Mexican descent adopted the behaviors and attitudes of the majority culture. Subjects were asked about a number of different aspects of acculturation including: place of birth, prefered language for speaking and writing, and ethnicity of friends. Each item was scored from 1 (Mexican only) to 5 (American only). An average score of 1 reflected no acculturation and 5 reflected complete acculturation.[16]

Socioeconomic Status. SES was measured with the Hollingshead Four Factor Index of Social Status.[17] To calculate SES, years of education was multiplied by 3 and job classification was multiplied by 5 and then these quantities were summed, resulting in a score ranging from 8 (unskilled workers) to 66 (professionals and proprietors of large buisnesses).

Number of Children. This item was measured by asking subjects the number of children that were currently living in the home.[14]

Age. Subjects were asked both their age and date of birth. Age was asked first and if a subject did not report age but did provide date of birth their age was calculated by subtracting their birth year from the current year.

TV Time. Subjects were asked "How often did you watch television or videos?" and "On average how long did you watch television or videos?" Total minutes spent watching television or videos was calculated by multiplying frequency by average time spent watching television or videos.[14]

Perceived Benefits of Walking for Exercise. Subjects were asked about ten specific benefits of walking for exercise (e.g., "Walking makes me feel good about myself") and asked to rate each item on a 5-point Likert-type scale ranging from 1 (never true) to 5 (always true).[15]

Perceived Barriers to Exercise. Perceived barriers were composed of 14 items which assessed barriers related to exercising in general. All survey subjects were asked about each barrier (e.g., "I do not have a safe place to exercise") and then asked to rate each barrier on a 5-point Likert-type scale ranging from 1 ("Never prevents me") to 5 ("Always prevents me").[15] Table 2 shows the most important perceived benefits and barriers to walking.

Sidewalk Availability. The availability of sidewalks was operationalized as the total length of sidewalks divided by the total length of streets (excluding highways) multiplied by 100.[18] Sidewalk availability was determined by examining black and white photographs with 1 ft resolution using ArcView software (ESRI, Redlands, CA). The photos were acquired by Surdex in 1996 and were subsequently bought by the Public Senate Board and are available free of charge through the PdNMapa Initiative funded by Paso del Norte. Availability was examined at the neighbor-

Table 2 Reasons for Walking and Barriers to Exercise for Participants Who Reported Walking for Exercise in the Past Month

	Reason	Mean + standard deviation
Top 5 reasons for men	1. To be healthy for self	4.78 ± 0.65
	2. To be healthy for family	4.76 ± 0.67
	3. Makes me feel good about myself	4.63 ± 0.90
	4. Gives me time to myself	4.50 ± 1.11
	5. Is easier on my body	4.36 ± 1.14
Top 5 reasons for women	1. To be healthy for self	4.78 ± 0.68
	1. To be healthy for family	4.78 ± 0.67
	2. Makes me feel good about myself	4.71 ± 0.76
	3. Is easier on my body	4.56 ± 0.94
	4. Gives me time to myself	4.52 ± 1.07
	5. Enjoy it more than other exercises	4.31 ± 1.21
Top 5 barriers for men	1. No time	2.07 ± 1.35
	2. Too hot	1.92 ± 1.31
	3. No motivation	1.71 ± 1.14
	4. No energy	1.61 ± 1.18
	5. Not enjoy	1.60 ± 1.14
Top 5 barriers for women	1. No time	2.06 ± 1.33
	2. Too hot	1.98 ± 1.31
	3. No energy	1.82 ± 1.27
	4. No partner	1.79 ± 1.36
	5. No motivation	1.78 ± 1.22

hood level, with "neighborhood" defined as the area within a 0.25-mi radius of a person's home.[19]

Number of Physical Activity Facilities. Several different types of physical activity facilities were examined in the current study: parks, gyms, schools, and biking/walking paths. ArcView software was used to count all of the facilities in each subject's community (2.5 mi-radius around subject's home). Data on all of the parks and biking/walking paths in El Paso was provided by the City of El Paso Parks and Recreation Department and data on all of the schools located in El Paso was provided by the Center for Environmental Resource Management (CERM). Gyms were located by using online yellow page listings.

Distance to Physical Activity Facilities. The shortest distance from each person's home to each of the different physical activity facilities was also calculated by using ArcView software. The shortest distance was found by following the streets centerline from each individual's home to the closest facility of each type (school, biking/walking path, gym, park). This method exhibited excellent inter-rater reliability ($r > 0.90$).

Slope. Slope was a measure of the average change in elevation (measured in feet) in a subject's neighborhood. It was calculated by subtracting the lowest elevation point in an individual's neighborhood from the highest elevation point. Slope data were purchased from Topo Depot (www.topodepot.com).

Land Use. Land use was operationalized as the number of nonresidential buildings divided by the total number of buildings in a subject's neighborhood multiplied by 100.[19-20] The City of El Paso Planning, Research, and Development Department provided a working draft of land-use data to be used for the current project.

Intersection Number and Type. Intersection density was operationalized as the total number of intersections in a subject's neighborhood. To determine the percentage of cul-de-sacs and four-way intersections, the number of cul-de-sacs or four-way intersections was divided by the total number of intersections and then these scores were multiplied by 100.

Population Density. Population density was operationalized as the number of individuals per square mile. Data on population density were retrieved from the US Census website (www.census.gov). Efforts were made to locate block-level data first since they are the most accurate representation of a subject's neighborhood; however, if census block-level data were not available, census tract-level data were used.

Procedure

Geocoding

To match survey data with GIS data, precise street addresses were needed. Since no data other than phone numbers was collected on the general health survey, several methods were attempted to locate an address for each subject. The first attempt involved matching the respondent's phone number to a database that was collected by the Paso del Norte Health Foundation when potential subjects called in response to the *Walk El Paso!* media campaign. If a subject's address was not available in this database then their phone numbers were used to locate their address using a "reverse people finder" (Excite website, www.excite.com). A total of 560 addresses were matched to subject's phone numbers using these 2 methods. ArcView software was used to geocode the locations of the 560 subjects with addresses, however, only 452 were successfully geocoded. The unsuccessful address matches could have occurred because the street was not included in the street centerline file, the street was spelled very similarly to another street that was included in the street centerline file, or the street had two different names and only one was included in the centerline file.

Once the environmental data were coded and linked to individual homes, they were transferred into an SPSS 10.0 (SPSS, Inc., Chicago, IL) file with the individual and social variables from the community-wide health survey. In SPSS, all of the variables were screened for outliers, normality, linearity, homoscedasticity, and multicolinearity before any analyses were performed. In the current study, several variables were truncated because of unacceptable skew or kurtosis.

Multiple stepwise regression was used to examine how the environment influenced total time spent walking, walking frequency, and walking duration after controlling for demographic, health, and behavioral variables. The demographic variables were entered at the first step, behavioral and health-related variables were entered at the second step, and the environmental variables were entered at the third step.

Because of the structure of the survey, individuals who did not report walking for exercise were not asked about benefits of walking or social support for walking. Since both of these constructs were of theoretical interest, separate analyses were performed for the entire sample (did not include social support or benefits) and the subsample that reported walking during the previous month (included social support and benefits). Frequency, duration, and total time spent walking were examined independently because certain factors might exert a stronger influence on how often individuals walk (i.e., high land use) while other factors could influence how long an individual walks (i.e., having more sidewalks in their neighborhood). Mean substitution was used to address the issue of missing data.

After subjects were geocoded ($N = 452$), the subjects who were successfully geocoded were compared with independent samples t-tests to the subjects who were not successfully geocoded ($N = 501$). A 2-way ANOVA was also performed to determine if there were differences between men and women or between subjects that reported walking for exercise and subjects that did not report walking for exercise during the previous month. Bonferrroni adjustments were made to control for Type I error.

Results

Subjects

Subject characteristics are shown in Table 1. Subjects were, on average, age 42 ± 17 y; slightly overweight with a BMI of 26.6 ± 5.6 kg/m^2 (41% normal weight, 37% overweight, and 21% obese); moderately acculturated, 3.1 ± 1.2 (possible range: 1 to 5); had SES levels of semi-skilled workers, 28 ± 17 (possible range: 8 to 66); had 1 ± 1 child living in the home; had self-reported good health; ate at least 1 serving of fruits or vegetables per day; and had less than one self-reported disease.

For the entire sample, 33% were completely sedentary, 22% were not sufficiently active, and 46% were engaging in the recommended amounts of physical activity. Women were somewhat more sedentary (35%) than men (27%). Walking was the most frequently cited activity as 48% of the sample reported walking (51% of women, 41% of men).

Of the 943 subjects with complete surveys, addresses could be located for 560, and 452 were successfully geocoded (48%). The subjects who had geocoded addresses did not differ significantly from the remaining sample on any of the walking, demographic, behavioral, or health-related variables with the exception of age. Subjects that had geocoded addresses were significantly older than subjects who did not (age 44 vs. 39 y).

A 2-way ANOVA was performed to determine if there were differences between subjects based on gender and walking status. Men were found to have higher acculturation ($P = 0.003$) and higher SES ($P = 0.003$) than women. No differences were found between those subjects that reported walking ($n = 227$) and those that did not walk during the previous month ($n = 225$).

For the entire sample, total time spent walking for exercise was related to higher SES ($P = 0.02$; $R^2 = 0.06$), walking frequency was related to fewer perceived barriers ($P = 0.03$; $R^2 = 0.07$), and walking duration was related to higher SES ($P = 0.02$), better overall health ($P = 0.40$), fewer perceived barriers to physical activity ($P = 0.02$), and living in a more residential area ($P = 0.04$; $R^2 = 0.08$). Among the subsample of subjects who reported walking for exercise in the past month, total time spent walking was related to older age ($P = 0.03$) and having fewer physical activity facilities in their neighborhood ($P = 0.05$; $R^2 = 0.11$). Walking frequency was related to older age ($P = 0.02$), fewer physical activity facilities ($P = 0.05$), and living in a more commercial neighborhood ($P = 0.02$; $R^2 = 0.11$). None of the variables were significantly related to walking duration ($R^2 = 0.09$). Results of the regression analyses are presented in Table 3 (all subjects) and Table 4 (subsample of walkers).

Table 3 Summary of Hierarchial Regression for All Participants[a]

Variable	Total time (β)	Frequency (β)	Duration (β)
Step 1			
Age	0.10	0.09	0.02
Acculturation	–0.04	–0.08	–0.04
SES	0.12[b]	0.08	0.13[b]
# of children	–0.00	0.02	–0.01
BMI	–0.09	–0.07	–0.07
Step 2			
TV time	–0.04	–0.04	0.00
Total barriers	–0.08	–0.11[b]	–0.11[b]
Fruit/vegetables	0.02	0.09	0.07
Disease	0.07	0.08	0.08
Overall health	–0.07	–0.09	–0.12[b]
Step 3			
Land–use	–0.03	–0.02	–0.11[b]
# of intersections	0.03	0.03	0.05
% of cul–de–sacs	–0.06	–0.04	–0.04
% of four–way	0.05	0.03	0.03
Slope	–0.03	0.00	–0.07
Density	0.01	0.05	0.02
# of facilities	–0.08	–0.04	0.02
Distance to facilities	0.01	–0.04	0.00
Sidewalk	0.02	–0.06	–0.05

Note. [a]Total time $R^2 = 0.04$ for Step 1; $\Delta R^2 = 0.06$ for Step 2 ($P < 0.001$); $\Delta R^2 = 0.04$ for Step 3 ($P < 0.02$). Frequency $R^2 = 0.04$ for Step 1; $\Delta R^2 = 0.06$ for Step 2 ($P < 0.001$); $\Delta R^2 = 0.04$ for Step 3 ($P < 0.02$). Duration $R^2 = 0.04$ for Step 1; $\Delta R^2 = 0.06$ for Step 2 ($P < 0.001$); $\Delta R^2 = 0.04$ for Step 3 ($P < 0.02$). [b]$P < 0.05$.

Table 4 Summary of Hierarchial Regression for the Subsample of Participants That Walked[a]

Variable	Total time (β)	Frequency (β)	Duration (β)
Step 1			
Age	0.18[b]	0.20[b]	0.03
Acculturation	0.02	–0.02	0.01
SES	0.08	–0.03	0.07
# of children	–0.01	0.01	–0.06
BMI	–0.12	–0.10	–0.10
Step 2			
TV time	–0.08	–0.06	0.01
Total barriers	–0.03	–0.04	–0.08
Fruit/vegetables	–0.10	–0.02	–0.04
Disease	–0.02	0.01	0.01
Overall health	0.06	0.05	0.03
Step 3			
Land–use	0.09	0.19[b]	–0.05
# of intersections	0.04	0.04	0.09
% of cul–de–sacs	–0.08	–0.07	–0.08
% of four–way	0.09	0.07	0.08
Slope	–0.03	0.04	–0.08
Density	–0.04	–0.03	–0.03
# of facilities	–0.24[b]	–0.24[b]	–0.12
Distance to facilities	0.04	–0.05	0.01
Sidewalk	0.15	0.07	0.05

Note. [a]Total time $R^2 = 0.04$ for Step 1; $\Delta R^2 = 0.06$ for Step 2 ($P = 0.14$); $\Delta R^2 = 0.05$ for Step 3 ($P = 0.33$). Frequency $R^2 = 0.05$ for Step 1; $\Delta R^2 = 0.01$ for Step 2 ($P = 0.97$); $\Delta R^2 = 0.04$ for Step 3 ($P = 0.34$). Duration $R^2 = 0.02$ for Step 1; $\Delta R^2 = 0.04$ for Step 2 ($P = 0.33$); $\Delta R^2 = 0.03$ for Step 3 ($P = 0.65$). [b]$P < 0.05$.

Discussion

This study is one of the first to examine how objectively measured environmental variables are associated with self-reported walking for exercise in a randomly selected, predominantly Hispanic sample living on the US–Mexico border. Land use was the only variable from the transportation literature that was related to walking as a leisure-time activity. Therefore, our study confirms previous research which has reported that different factors influence the decision to walk for exercise compared to the literature describing walking as a means of transportation.[11, 12] Interestingly, land use was found to have differential impacts on self-reported walking for exercise in the entire sample and in the subsample of subjects who reported walking during the previous month. For the subsample, living in a more commercial neighborhood was related to walking more often. This finding is similar to what has been reported in the transportation literature where more trips are made by walking or biking when individuals live in areas with higher land use.[21, 22] When the entire sample was examined, however, subjects who lived in more residential neighborhoods were found to spend more time walking for exercise. It is possible that subjects who are regular walkers choose to walk for transportation in urban settings to shop and complete routine errands, while subjects who do not walk for exercise on a regular basis are more likely to walk only in their neighborhood and do not try to incorporate walking into activities of daily life. This is consistent with research from the physical activity literature which has shown that the presence of local shops within walking distance is positively related to walking.[23, 24]

In addition, people who are not regularly active might perceive walking in more urban areas in El Paso, with much more traffic, as less pleasant and safe than walking in more residential areas with less traffic and more pleasant scenery. Since traffic speed, perceived pleasantness of neighborhood, and type of nonresidential building was not examined in the current study, however, further research is needed to determine how objective measures of land use are related to walking for exercise.

It is also important to note that several of the proposed relationships were not supported in the current study. An unexpected negative association was found between number of physical activity facilities in the community and total time spent walking and walking frequency in the subsample of subjects that reported walking. In addition, no association was found between distance to physical activity facilities and walking. These findings are in contrast to previous studies which have shown a negative association between physical activity and objective measures of distance.[6, 25] Giles-Corti and Donovan,[25] however, found that individuals were willing to travel longer distances to use certain types of facilities (golf courses, swimming pools, etc.) but not others (public open spaces, tennis courts, etc.). Therefore, if certain facilities were seen as attractive to individuals living in El Paso they might have traveled further to use these facilities or they could have exercised longer at these facilities given that they were farther away.

In general, the findings with respect to the relationship between self-reported physical activity and self-reported access to physical activity facilities have been mixed. A handful of studies have found a positive association between self-reported convenience of physical activity facilities and time spent in physical activity.[26, 27] Voorhees and Young,[28] however, found that self-reported access to facilities both within an individual's neighborhood and within walking distance had a negative association with engaging in physical activity among a group of urban Latinas. While access was self-reported by these women, their results provide some support for the findings in the current study. It might be that the relationship between distance to facilities and physical activity is more complicated in certain Hispanic subgroups, such as the media target for the *Walk El Paso!* campaign (middle-age Hispanic women).

The relationship between walking and both of the facility variables (distance and number) could also be an artifact because both the distance to physical activity facilities and the number of physical activity facilities were composite measures which included several different types of facilities. Combining all of these diverse facilities might have obscured the effects that a particular type of facility had on walking. In addition, the number of facilities within a 2.5-mi radius were counted in the present study and a shorter distance could have been a more appropriate measure of facilities that were actually used by subjects since many different facilities (38 ± 18) were found within 2.5 mi of a person's home.

From previous research it was expected that change in elevation would have a negative effect on walking for exercise.[6, 29] These studies, however, measured change in elevation as the difference between "home" and the physical activity facility. In the current study, the change in elevation between subject's homes and different facilities was not measured; instead, the total change in slope in the individual's neighborhood was used. This measure might have been more related to the self-reported presence of hills, which has been found to have either a positive or nonsignificant effect on physical activity.[30, 31] The null finding for slope could have also occurred because only lower quality data was available for a section of El Paso with large changes in elevation. Future studies are needed to determine how to properly operationalize slope to assess its influence on walking as both a means for transportation and as a leisure-time activity.

Objectively measured sidewalk availability was not significantly associated with walking in any of the analyses. Most of the studies examining the impact of sidewalks on physical activity have been done using self-report for both constructs with mixed results, some positive[26, 32] and some null. [31, 33-35] It is important to note, however, that individuals' perceptions of sidewalk availability has only fair agreement with objective measures of actual sidewalk availability across all levels of physical activity (kappa = 0.37).[36]

To date, only 1 study has been published that used an objective measure of sidewalk availability and they found a positive, albeit nonsignificant, association between sidewalk availability and walking.[37] Our findings using objectively assessed sidewalk availability support their conclusions in direction and strength. The lack of a strong and consistent association between objectively assessed sidewalk availability and self-reported walking for exercise might have been caused by the low number of individuals who reported walking for exercise in their neighborhood. In the entire sample only 48% of subjects reported walking during the previous month ($n = 227$) and for those who did walk, only 31% walked in their neighborhood ($n = 68$). This was consistent with the *Walk El Paso!* campaign as many of the media messages emphasized walking in parks, schools, and malls.

There was also no significant association between walking and population density, intersection density, percentage of 4-way intersections, or percentage of cul-de-sacs. These findings are added to a mixed set of literature. A recent study by Saelens and colleagues[11] reported that there were no differences in total time spent walking between individuals who lived in a high-walkability neighborhood (high land use, high density, high connectivity) compared to those in a low-walkability neighborhood (low land use, low density, low connectivity). They did find, however, that individuals were more likely to walk for errands in the high-walkability neighborhoods.[11] De Bourdeaudhuij and colleagues[26] also did not find an association between walking and population density, availability of bike lanes, or street connectivity. In contrast, Ewing and colleagues[38] found that increased sprawl (low density, low land use, low connectivity) at both the metropolitan and county levels was related to lower levels of leisure-time walking. These differences might be due in part to the different methodologies employed in each study to measure both the environmental variables and physical activity, and future research is clearly needed to disentangle these relationships.

While there were several important findings in the current study there were also several limitations that must be acknowledged. For instance, no additional information was analyzed on park size or quality which could have helped explain why people in El Paso walked for exercise. Several studies have found that different aspects of parks such as their proximity, size, aesthetics, design, and having tree-lined walkways are positively related to their use.[24, 39]

In addition, sidewalk availability was determined by examination of aerial photographs. Several problems were encountered using this methodology, including the presence of trees in the Rio Grande valley, missing aerial photographs around the Ft. Bliss military installation (unavailable because of security concerns), and, in the outlying areas of El Paso, and no data was collected on sidewalk quality (cracks, obstructions, etc.). For the locations that were missing aerial photos (7.5%), visual inspection was used to determine if sidewalks were available along the streets.

Another limitation is that telephone surveys can lead to an under-representation of individuals in the lowest income brackets since they might not have phone service. In 1998, however, telephone coverage in the US was estimated to be 95%.[14] In addition, Escobedo and colleagues[40] found that telephone surveys were valid for population-based research along the US–Mexico border and provided results identical to those obtained in face-to-face interviews. Subjects were also not contacted to determine if the correct address was found using the various methods previously mentioned. Subjects that were successfully geocoded were older than those subjects that were not and this might have had an effect on the final results because age was found to be positively related to walking. The data used was also cross-sectional; therefore no definitive inferences about causality can be made since it is impossible to identify temporal relationships with this type of data.

Nonetheless, there were many strengths which increase the validity of these findings. One of these strengths was a representative community sample. Random digit dial methodology was used to select individuals for the survey and individuals were selected from all areas of El Paso County. In addition, the environmental variables were objectively measured and previous research has shown that the use of objective data eliminates individual biases (i.e., active subjects might be more aware of facilities) and provides a more accurate representation of the environment.[36, 41] Very detailed land-use data was provided by the City of El Paso's Planning, Research, and Development Department for use in the current study, which was available for 87% of the sample. Population density was also calculated at the most precise level (census block) for 86.5% of the sample. The additional 13.5% was calculated at the next most specific level (census tract). Finally, the current study is one of the first to use a variety of environmental indicators which provided a multifaceted representation of neighborhood and community characteristics.

While the environmental variables did not explain large amounts of variance in the walking models it does not mean that these findings are unimportant. Changing the environment to make it more suitable for physical activity could affect entire populations over long periods of time. Finally, many of the associations between the built environment and walking for exercise were unexpected and future research should address these findings before conclusions can be made about their impact on physical activity and health.

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