Published in final edited form as:

Am J Health Behav. 2013 March ; 37(2): 277–282. doi:10.5993/AJHB.37.2.15.

Neighborhood Preference, Walkability and Walking in Overweight/Obese Men

Gregory J. Norman, PhD,

Department of Family and Preventive Medicine, University of California, San Diego, CA

Jordan A. Carlson, MA,

Department of Family and Preventive Medicine, University of California, San Diego, CA

Stephanie O'Mara, MPH,

Department of Family and Preventive Medicine, University of California, San Diego, CA

James F. Sallis, PhD,

Department of Family and Preventive Medicine, University of California, San Diego, CA

Kevin Patrick, MD, MS,

Department of Family and Preventive Medicine, University of California, San Diego, CA

Lawrence D. Frank, PhD, and

School of Community and Regional Planning, University of British Columbia, Vancouver BC, CANADA

Suneeta V. Godbole, MPH

Department of Family and Preventive Medicine, University of California, San Diego, CA

Abstract

Objectives—To investigate whether self-selection moderated the effects of walkability on walking in overweight and obese men.

Methods—240 overweight and obese men completed measures on importance of walkability when choosing a neighborhood (selection) and preference for walkable features in general (preference). IPAQ measured walking. A walkability index was derived from geographic information systems (GIS).

Results—Walkability was associated with walking for transportation ($p = .027$) and neighborhood selection was associated with walking for transportation ($p = .002$) and total walking ($p = .001$). Preference was associated with leisure walking ($p = .045$) and preference moderated the relationship between walkability and total walking ($p = .059$).

Conclusion—Walkability and self-selection are both important to walking behavior.

Keywords

built environment; geographic information systems; physical activity; self-selection

Considerable evidence has emerged supporting the relationship of neighborhood walkability with walking for transportation and total physical activity.¹⁻³ Walkable neighborhoods are those in which residents can walk to nearby destinations. Walkable neighborhoods have greater land use mix, street connectivity, and residential density, which have each been associated with greater levels of physical activity.⁴ In one study, adults living in high- vs. low-walkability neighborhoods engaged in 41 more minutes of total physical activity per week.²

Despite multiple findings supporting associations between walkability and physical activity, the possibility of active people purposefully “self-selecting” into walkable neighborhoods has been a commonly-cited threat to causal interpretations.⁵ Self-selection is often measured by asking people if factors related to walkability were considered when choosing their neighborhood, or if they prefer living in more walkable areas in general. The evidence to date suggests that active people do self-select into high-walkability neighborhoods, but self-selection alone does not explain the associations between neighborhood walkability and physical activity.^{5,6} For example, walkability was related to objectively measured moderate-to-vigorous physical activity (MVPA) after controlling for self-selection in a large sample of adults.²

It is possible that walkability has a differential effect on walking for people who self-select compared to those who do not chose to live in a walkable neighborhood. The few studies that have investigated this had mixed findings. Two studies found a greater effect of walkability on walking for participants who self-selected vs. those who did not self-select.^{7,8} However, a third study found a greater effect of walkability on active transport for participants who did not self-select vs. those who did.⁹

Understanding how self-selection and walkability interact in explaining walking can provide insight into opportunities for promoting walking. For example, people living in a walkable neighborhood who did not self-select may benefit from psychosocial and promotional interventions, while those who self-selected may benefit from efforts to improve neighborhood walkability.⁵ Because of the aforementioned mixed findings, further studies are warranted.

It is of particular importance to understand the effect of self-selection and walkability on walking in overweight/obese individuals because of the increased risk for cardiovascular disease, type 2 diabetes and cancer, which can be prevented with increased physical activity.^{10,11} Walkability has been linked to higher BMI in U.S. adults.¹² Although the overall prevalence of obesity (BMI ≥ 30 kg/m²) is higher among women (35.5%) than men (32.2%), the prevalence of obesity in men continues to increase,¹³ and men tend to not engage in traditional weight loss programs. Thus, understanding the role of the environment in men’s physical activity may help with energy balance for weight loss through active commuting and walking to destinations. This strategy for increasing men’s activity is particularly relevant since given the same environment, men perceive it to be more walkable than women.¹⁴

The present study used 2 measures of self-selection to investigate whether self-selection moderated the effects of walkability on walking in overweight and obese men. We hypothesized that among men who did not express a preference for living in a walkable neighborhood, those who lived in one would participate in more walking.

METHODS

Participants and Procedures

Participants were overweight and obese men enrolled in a randomized controlled trial of Internet-based health promotion and weight control intervention specifically for men targeting physical activity and multiple dietary outcomes.¹⁵ Participants resided throughout San Diego County, California. San Diego has a mild temperate climate year-round and mostly suburban and some urban type neighborhoods in the city of San Diego and the 17 other incorporated cities and towns in the San Diego County. The unincorporated areas of San Diego County are primarily rural. The main study consisted of 441 participants. The present study included the subsample of 240 participants that completed the neighborhood self-selection survey.

Participants were recruited from the community through newspaper and radio advertisements and posted fliers. Eligibility criteria included being male, having a BMI between 25 and 40, having Internet access, being in good general health, able to read and speak English, and able to engage in moderate intensity physical activity. Potential participants completed an on-line screening survey that included screening for eating disorders. Eligible participants signed consent forms and completed survey measures on computers at the research office. For the current study, all measures, with the exception of the neighborhood self-selection survey, were completed by participants at the baseline visit prior to randomization into study conditions. The neighborhood self-selection survey was added to the 12-month assessment. Differences between study arms were not statistically significant for high and low neighborhood selection and preference. As a result, the design for the present study was considered cross-sectional.

Measures

Demographics—Participants self-reported their age, ethnicity (non-Hispanic white or non-white), education (less than a college degree or at least a college degree) and marital status (married/living with partner or not married/living with partner).

Body Mass Index (BMI)—Height was measured with a wall stadiometer, and weight was measured with a calibrated digital scale. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2).

Walkability Index—The walkability index was computed the same as in other studies.^{2,16,17} Data from the county-level tax assessor, regional land use at the parcel level, and street networks were integrated into geographic information systems (GIS) to create a walkability index for each participant based on a 1-mile buffer around the home. The walkability index consisted of the sum of z-scores of measures of residential density, retail

floor area ratio, intersection density, and land use mix. Higher scores on the walkability index indicated more facilitators of walking (eg, connected routes and nearby walking destinations). Details on computation of the walkability index and its validity are reported elsewhere.¹⁶ The distribution of walkability scores was categorized into low- vs. high-walkable neighborhoods by a median split.

Neighborhood self-selection—For the “neighborhood selection” variable, participants rated the importance of 4 factors in their decision to move to their current neighborhood. Items were rated on a 5-point scale and higher scores corresponded to greater importance of walkable features in selection of the neighborhood. The factors were ease of walking, near public transit, near shops and services, and near outdoor recreation. The items were adopted from a previously developed tool¹⁷ and have been used in numerous studies.^{2,8} The 4-item scale had high internal consistency reliability, Cronbach’s $\alpha = .79$. A scale score was created by taking an average of the 4 items and a median split was used to categorize participants as placing low vs. high importance on walkability when choosing their neighborhood.

“Neighborhood preference” was defined as a general inclination toward one of 2 types of neighborhoods and was calculated from 3 items describing neighborhood characteristics related to walkability.⁷ The instructions stated, “...imagine moving to a different neighborhood. These questions ask you about the kind of neighborhood you would hope to find.” The items required the participant to make a choice between specific tradeoffs of travel convenience and neighborhood design with each choice providing particular benefits and disadvantages. This type of survey measure is used by marketing professionals to gauge product demand and attributes that consumers value when choosing between competing products.⁷ The first item described A) low and B) high residential density; the second described A) single and B) mixed land use; the third described A) low and B) high street connectivity. Participants rated their preference for each scenario (ie, “A” or “B”) on an 11-point scale with the following anchors: strongly prefer neighborhood A (0); somewhat prefer neighborhood A (3); neutral (5); somewhat prefer neighborhood B (7); and strongly prefer neighborhood B (10). Items were scored so that higher scores denoted greater preference for a high-walkability neighborhood and a scale was created from the average of the scores from the 3 items. The scale had moderate internal consistency reliability with Cronbach’s $\alpha = .67$. A median split of the distribution categorized participants as having a low vs. high preference for living in a walkable neighborhood.

Physical activity—Participants completed the long version of the International Physical Activity Questionnaire (IPAQ) that assessed transportation and leisure walking over the previous 7 days. This questionnaire was found to have good test-retest reliability and validity compared to accelerometers.¹⁸ Reported frequency (days per week during last 7 days) and duration (hours and minutes per day) for transportation and leisure walking were used to derive 2 total MET-minutes per week variables by multiplying estimated weekly minutes by 3, which is the metabolic energy expenditure multiple above resting energy expenditure. Transportation and leisure walking were also combined to create a total walking variable. Neighborhood walkability has been related to transportation walking in many studies.¹ The

relationship between walkability and leisure walking is less clear, although positive associations have been found.¹

Analysis

The outcome variables were walking for transportation, walking for leisure, and total walking (3 models total). Natural log transformation was used to better approximate normality for each outcome variable because the distributions were positively skewed. The independent variables were centered on zero (ie, $-.5$ and $.5$) so the intercept would reflect the grand mean of the outcome and to avoid collinearity when testing interactions. Age, BMI, education, and ethnicity were included as covariates in all models and were either mean centered (age and BMI) or centered on zero (education and ethnicity). Model main effects were considered statistically significant at $p < .05$. Type I error for 2-way interaction effects was set at $p < .10$ to gain statistical power. Line graphs of significant interactions plotted the estimated activity values (in antilog MET-minutes/week) by independent variables with standard error bars after adjusting for all variables in the model. SPSS version 17.0 was used for all analyses.

RESULTS

Mean age for the 240 participants was 44.9 (SD = 7.5) and mean BMI was 32.5 (SD = 3.8). Seventy-six percent of participants were white, 71% had at least a college degree, and 70% were married or living with a partner. Participants reported engaging in an average of 410 MET-minutes/week of walking for transportation (SD = 1112), 230 MET-minutes/week of walking for leisure (SD = 441), and 640 MET-minutes/week of total walking (SD = 1399). Distributions of the categorized independent variables are presented in Table 1.

In the multiple regression analyses, the 3 models explained between 5 and 13% of the variance of the activity outcomes (Table 2). In the first model, walking for transportation was associated with the walkability index ($\beta = 0.15$; $p = .027$) and neighborhood selection ($\beta = 0.21$; $p = .002$). In the second model, walking for leisure was associated with neighborhood preference ($\beta = 0.13$; $p = .045$). In the third model, total walking was associated with neighborhood selection ($\beta = 0.22$; $p = .001$). There was also an interaction between walkability and neighborhood preference in the total walking model ($\beta = -0.12$; $p = .059$).

Plotting the adjusted means of the interaction indicated that when neighborhood preference for living in a walkable neighborhood was high, total walking MET min/week did not differ between men in high and low walkable neighborhoods. However, when neighborhood preference for living in a walkable neighborhood was low, men in high walkability neighborhoods walked more than men in low walkability neighborhoods (Figure 1).

DISCUSSION

Two constructs defining neighborhood self-selection were tested in relationship to the association between neighborhood walkability and physical activity. First, neighborhood selection assessed the importance of walkability-enhancing factors in men's decision to

move to their current neighborhood. We found neighborhood selection was positively related to walking for transportation and total walking, indicating that the perceived importance of walkability factors was associated with men's amount of walking, regardless of the actual neighborhood walkability. Thus, it appears that men who place a high value on walkability were likely to walk, wherever they lived. This is evidence of a self-selection effect. However, neighborhood selection did not moderate the relationship between walkability and any of the physical activity measures, and walkability was related to walking for transportation, even when adjusting for neighborhood selection.

The second construct measured, neighborhood preference, assessed the type of neighborhood one would hope to find when moving to a new neighborhood. Preference represented the ideal neighborhood to live in and was presented as a choice between a suburban neighborhood and a more mixed land use, denser urban neighborhood. Neighborhood preference was positively related to only leisure walking. The preference for a more urban neighborhood may reflect general positive beliefs about what constitutes a health-enhancing neighborhood and may also reflect more general attitudes about an ecologically friendly environment (eg, having local green space, using public transportation, shopping locally). Preference for an urban neighborhood might be expected to be related to more walking for transport, but that was not found. Thus, preferring urban neighborhoods may indicate a desire for a healthier neighborhood that would be good for leisure walking.

As expected, neighborhood walkability was directly and positively related to walking for transportation but not related to leisure walking. This is consistent with other studies that have found associations between walkability and walking for transportation even after adjusting for neighborhood selection.^{2,7,19} But neighborhood selection also contributed significantly to the model for transportation walking, providing further evidence that active people do self-select into walkable neighborhoods and that walkability and selection are both important to walking behavior.⁵⁻⁸

The relationship between walkability and total walking was moderated by preference. When men's preference was for the more walkable urban neighborhood, total walking was not related to the actual walkability of the neighborhood. This suggests that when preference is for the walkable neighborhood, this belief 'over-rides' the walkability of the neighborhood for men. However, when men's preference was for the more suburban neighborhood, walkability was related to total walking with men walking more in the higher walkable neighborhoods than the lower walkable neighborhoods. Even when men did not endorse the desire to live in a more walkable neighborhood, having features that facilitate walking in such neighborhoods was associated with men walking more than those in lower walkable neighborhoods. This is an important finding because it suggests a walkable neighborhood could encourage walking even among those who prefer low-walkable locations. The choice of walking, rather than driving to destinations, may be more desirable when parking a car is inconvenient, when public transportation options are convenient, and when desired destinations are close by. Perhaps the modeling of others walking in the neighborhood also plays a role.

This interaction of preference and walkability related to walking is consistent with the pattern of results found by Van Dyck and colleagues.⁹ However, Owen et al found an interaction effect in the opposite direction for neighborhood selection and walking for transport.⁸ Walking did not vary by walkability for low self-selection but did for high self-selection, with those in higher walkability neighborhoods walking more for transport than those in lower walkability neighborhoods. It is not known what factors determine these varying patterns of relationships. There may be personal and cultural factors that play a role in determining when neighborhood preference interacts with the walkability of a neighborhood to influence walking.

Strengths and Limitations

Strengths of the study included using GIS to determine neighborhood walkability and the use of multiple-item measures of neighborhood selection and preference. It is not known to what extent the current findings generalize beyond the sample of overweight men. While the pattern of results was consistent with Van Dyck and colleagues' sample of adults in Belgium,⁹ additional studies are needed to determine the robustness of the results in other population segments. Our study used a direct questioning method to determine self-selection and preference in data collected in a cross-sectional sample. Studies using other methodological approaches as outlined by Cao et al such as propensity score methods and selection models would further determine consistency of the pattern of results.⁶ Other study limitations include using a self-report measure of physical activity, which could be biased due to retrospective recall and the tendency to over-report physical activities. The sample size limited the statistical power of the regression models.

Implications for Policy and Programs

Understanding the relationship between neighborhood self-selection and walkability on physical activity is important because experimental studies where individuals are randomized to different neighborhood conditions are not practical. Separating self-selection into the importance of factors in the *selection* of current type of neighborhood and *preference* for ideal neighborhood type in which to live helped to clarify when neighborhood self-selection and walkability relate to walking. Both factors made independent contributions to explaining walking for transport. In fact, actual walkability, selection, and preference were all independent correlates of walking outcomes. However, neighborhood preference interacted with walkability when predicting total walking. The interaction suggested that those preferring walkable neighborhoods found ways to walk wherever they were living. This suggests that public health programs should emphasize the benefits of walking and finding places to walk to help establish and enhance positive attitudes about walkable neighborhoods. The promise of policies to enhance walkability was indicated by the finding that, among men who preferred suburban neighborhoods, those living in walkable neighborhoods walked more. Thus, living in a walkable neighborhood may "attract" men to walk more, despite their preference. This is an argument for zoning policies and building codes that encourage or require development of walkable communities.

Human Subjects Statement

The study was approved by the university institutional review board, and all participants provided written informed consent.

References

1. Saelens BE, Handy SL. Built environment correlates of walking: a review. *Med Sci Sports Exerc.* 2008; 40(7):S550. [PubMed: 18562973]
2. Sallis JF, Saelens BE, Frank LD, et al. Neighborhood built environment and income: examining multiple health outcomes. *Soc Sci Med.* 2009; 68(7):1285–1293. [PubMed: 19232809]
3. Bauman, AE.; Bull, FC. Environmental Correlates of Physical Activity and Walking in Adults and Children: A Review of the Reviews. London: National Institute of Health and Clinical Excellence; 2007. (online). Available at: <http://www.gserve.nice.org.uk/nicemedia/live/11679/34740/34740.pdf> [Accessed May 8, 2012]
4. Frank LD, Schmid TL, Sallis JF, et al. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTAQ. *Am J Prev Med.* 2005; 28(2):117–125. [PubMed: 15694519]
5. Cao XJ, Mokhtarian PL, Handy SL. Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Reviews.* 2009; 29(3):359–395.
6. Handy, S.; Cao, XJ.; Mokhtarian, P. Active Travel: The Role of Self-selection in Explaining the Effect of Built Environment on Active Travel (online). San Diego: Active Living Research; 2009. Available at: http://activelivingresearch.org/files/ALR_Brief_SelfSelection.pdf [Accessed May 8, 2012]
7. Frank LD, Saelens BE, Powell KE, Chapman JE. Stepping towards causation: do built environments or neighborhood and travel preferences explain physical activity, driving, and obesity? *Soc Sci Med.* 2007; 65(9):1898–1914. [PubMed: 17644231]
8. Owen N, Cerin E, Leslie E, et al. Neighborhood walkability and the walking behavior of Australian adults. *Am J Prev Med.* 2007; 33(5):387–395. [PubMed: 17950404]
9. Van Dyck D, Deforche B, Cardon G, De Bourdeaudhuij I. Neighbourhood walkability and its particular importance for adults with a preference for passive transport. *Health & Place.* 2009; 15(2):496–504. [PubMed: 18974020]
10. Poirier P, Giles TD, Bray GA, et al. Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss: an update of the 1997 American Heart Association scientific statement on obesity and heart disease from the Obesity Committee of the Council on Nutrition, Physical Activity, and Metabolism. *Circulation.* 2006; 113(6):898. [PubMed: 16380542]
11. U.S. Department of Health and Human Services. [Accessed February 10, 2012] 2008 Physical Activity Guidelines for Americans. 2008. Available at: <http://www.health.gov/paguidelines/guidelines/default.aspx>
12. Ewing R, Schmid T, Killingsworth R, et al. Relationship between urban sprawl and physical activity, obesity, and mortality. *Am J Health Promot.* 2003; 18(1):47–57. [PubMed: 13677962]
13. Flegal KM, Carroll MD, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999–2008. *J Am Med Assoc.* 2010; 303(3):235–241.
14. Garcia Bengoechea E, Spence JC, McGannon KR. Gender differences in perceived environmental correlates of physical activity. *Int J Behav Nutr Phys Act.* 2005; 2:12. [PubMed: 16159404]
15. Patrick K, Calfas KJ, Norman GJ, et al. Dietary and physical activity outcomes in a twelve-month web-based intervention for overweight men. *Ann Behav Med.* 2011; 42:391–401. [PubMed: 21822750]
16. Frank LD, Sallis JF, Saelens BE, et al. The development of a walkability index: application to the neighborhood quality of life study. *Br J Sports Med.* 2009; 44:924–933. [PubMed: 19406732]
17. Frank LD, Sallis JF, Conway TL, et al. Many pathways from land use to health: associations between neighborhood walkability and active transportation, body mass index, and air quality. *J Am Plann Assoc.* 2006; 72(1):75–87.

18. Craig CL, Marshall AL, Sjoström M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003; 35(8):1381. [PubMed: 12900694]
19. Handy SL, Cao X, Mokhtarian PL. The causal influence of neighborhood design on physical activity within the neighborhood: evidence from Northern California. *Am J Health Promot.* 2008; 22(5):350–358. [PubMed: 18517096]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
Walkability by Preference Interaction in Explaining Total Walking MET-minutes/week

Table 1

Distribution of Independent Variables (N=240)

	Percent in Group (Range of Scores)	
	Lowest Group	Highest Group
Walkability Index	57.1% (−13.44 – 0.00)	42.9% (0.01 – 25.42)
Neighborhood Selection	55.5% (1.00 – 3.00)	44.5% (3.01 – 5.00)
Neighborhood Preference	51.0% (0.00 – 5.33)	49.0% (5.34 – 10.00)

Relation of Self-selection and Walkability to Log Transformed MET-minutes/week of Walking^{ab} (N=240)

Table 2

	Walking for Transportation (R ² = .097)			Walking for Leisure (R ² = .052)			Total Walking (R ² = .133)		
	B (95% CI)	β	p	B (95% CI)	β	p	B (95% CI)	β	p
Intercept	3.87 (3.38, 4.36)	-	-	4.78 (4.24, 5.32)	-	-	4.97 (4.54, 5.40)	-	-
Walkability Index	0.87 (0.10, 1.65)	.15	.027	0.17 (-0.68, 1.01)	.03	.698	0.55 (-0.13, 1.23)	.10	.112
Neighborhood Selection	1.23 (0.47, 1.98)	.21	.002	0.34 (-0.49, 1.17)	.05	.423	1.18 (0.51, 1.85)	.22	.001
Neighborhood Preference	-0.28 (-1.02, 0.46)	-.05	.461	0.83 (0.02, 1.64)	.13	.045	0.05 (-0.60, 0.70)	.01	.885
Walkability X Selection Interaction	-0.62 (-2.13, 0.90)	-.05	.423	0.54 (-1.12, 2.19)	.04	.523	-0.17 (-1.50, 1.16)	-.02	.799
Walkability X Preference Interaction	0.28 (-1.20, 1.77)	.02	.709	-0.43 (-2.05, 1.19)	-.03	.602	-1.25 (-2.56, 0.05)	-.12	.059

Note.

B unstandardized coefficient

CI confidence interval

β standardized coefficient

^aThe walking outcome variables were log transformed

^b Adjusted for age, BMI, education, and ethnicity