

Building the Evidence—U.S. Approaches

The Relationship Between Convenience of Destinations and Walking Levels in Older Women

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Abstract

Purpose. To examine the relationship between physical activity and (1) convenience of destinations, measured by whether destinations (such as a park, trail, businesses, and services) are within walking distance of the home, and (2) participants' perception of the quality of their neighborhood surroundings for walking, captured with a global neighborhood "walkability" rating.

Design. Cross-sectional analysis of data obtained in 1999.

Setting. Community in southwest Pennsylvania.

Subjects. Older Caucasian women ($n = 149$, mean age = 74.2 years). Response rate = 79%.

Measures. Walking levels, leisure-time physical activity, and features of the neighborhood environment were measured with interviewer-administered questionnaires. Physical activity was also measured objectively with a pedometer.

Results. Living within walking distance (defined as within a 20-minute walk of home) of a park; biking or walking trail; or department, discount, or hardware store was related to higher pedometer readings ($p < .01$). In addition, there was a positive trend between the sum of destinations within walking distance of home and activity levels measured by pedometer and questionnaire ($p < .01$). There was also a positive trend between participants' neighborhood "walkability" rating and activity levels measured by pedometer and questionnaire ($p < .01$).

Conclusion. These findings suggest that the ability to make utilitarian walking trips from home and the perception of having favorable neighborhood surroundings for walking are associated with increased physical activity levels in older women. (*Am J Health Promot* 2003;18[1]:74–82.)

Key Words: Physical Activity, Environment, Women, Pedometer, Prevention Research

INTRODUCTION

Because of the growing epidemic of inactivity and obesity across the nation, finding strategies to increase physical activity participation at the community level is a public health priority.¹ Thus, it is valuable to understand the influence of the physical environment, which has the potential to affect the physical activity levels of entire populations by removing barriers and creating opportunities for people to be more active in their daily lives.^{1–3}

Although research investigating environmental influences on physical activity participation is still at an early stage,⁴ there is mounting evidence that several aspects of the physical environment are associated with physical activity. In particular, access to recreational and athletic facilities^{5–10} and measures of neighborhood aesthetics^{10–14} have been significantly associated with physical activity levels. However, evidence is limited, and research evaluating other environmental factors, such as safety,^{12,15,16} traffic,^{10–12,14} presence of sidewalks,^{8,11,12} unattended dogs,^{10–12} hills,^{5,10,11} and overall neighborhood environment^{17–19} is less conclusive. Therefore, further research is needed to continue to identify factors in the physical environment that are related to physical activity, particularly in our least active populations.

Older women are one of the least active groups in the United States, with 51% of women aged 65 to 74 and 66% of women aged 75 and older reporting no leisure-time activity, compared to 38% of the general

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population.²⁰ In addition, they are one of the least studied populations in the physical activity literature,^{12,21} despite evidence that older women have much to gain from increasing their physical activity levels. Research has demonstrated that regular physical activity helps prevent or improves several of the health conditions that contribute to their comparatively high morbidity, such as osteoporosis and related hip fractures,^{22–26} depressive symptoms,^{27–30} arthritic pain,³¹ heart disease,³² and general physical limitations.^{33,34}

The current investigation examines the relationship between factors in the neighborhood environment and the physical activity levels of a cohort of older women who participated in a 15-year follow-up evaluation to a randomized controlled trial of a walking intervention (1982–1985) in Pittsburgh, Pennsylvania. Specifically, this study assesses whether convenience of destinations, measured by whether specific destinations (including parks, trails, and various types of businesses and services) are within walking distance of the home, is associated with both walking and total physical activity levels. In addition, this study evaluates whether participants' perception of how suitable their overall neighborhood surroundings are for walking, captured with a global neighborhood "walkability" rating, is associated with physical activity levels.

We address several shortcomings of past research in this area beyond studying one of the least active groups in the United States. First, we expand upon past measures of physical activity, which have previously been limited to subjective questionnaires, by using both a physical activity questionnaire and an objective activity monitor. In addition, we focus on measuring aspects of the environment that might be related to walking from home, since walking is the most common type of physical activity across all ethnic,^{35,36} income,^{35,36} and age^{35,36} groups, and the majority of Americans prefer to do their physical activity at or from their home.³⁷

METHODS

Design

This cross sectional analysis uses data from a 1999 to 2000 follow-up assessment of a randomized controlled trial of a walking intervention that took place in Pittsburgh, Pennsylvania, from 1982 to 1985.^{38,39} The 1999 to 2000 follow-up consisted of a comprehensive evaluation at a clinic, with measures of health status, functional status, and physical activity levels (both by questionnaire and a physical activity monitor), and an interviewer-administered telephone survey with questions regarding the neighborhood environment.

Sample

The original cohort of the 1982 to 1985 walking intervention was made up of 229 Caucasian postmenopausal women from the Pittsburgh area. Participants were community-dwelling volunteers recruited by print advertisements and word-of-mouth. At time of entry into the original trial (1982), participants were 50 to 65 years of age, apparently healthy, at least 1 year postmenses, free from estrogen replacement therapy, and free of physical limitations that might preclude walking. At the end of the clinical trial (1985) women who participated in the walking intervention were significantly more active, based on both objective and subjective physical activity measures, compared to the control group.³⁹

One hundred eighty-eight women (82% of the original cohort) participated in the 1999 follow-up (20 were deceased, 8 were too sick to participate, 10 were lost to follow-up, and 3 refused to participate). The 149 women (79% of the 1999 cohort) who completed the physical activity questionnaire, physical activity monitor, and environmental questionnaire were included in the present analysis.

This study was approved by the University of Pittsburgh Institutional Review Board, and informed consent was obtained from participants for all aspects of the study prior to their participation.

Measures

Physical Activity. Walking and total leisure-time physical activity levels were assessed using a modified version of the Paffenbarger Activity Questionnaire, which measures frequency and duration of walking and other leisure-time activities, such as gardening, organized sports, and individual athletic activities.^{40,41} The reliability and validity of the Paffenbarger Activity Questionnaire have been established in several studies,⁴² including populations of older women.^{43,44} In the modified version, walking for exercise, transportation, or pleasure as well as physical activity from sports and recreation was assessed for the last year by asking participants the number of months per year, number of times per week, and average time per session spent participating in each activity. From the frequency, duration, and estimated intensity of activities, estimates of kilocalories (kcal) expended per week from walking alone and from all leisure-time physical activities plus walking (referred to as total activity in this paper) were calculated.

Physical activity level was also measured objectively using the Yamax DigiWalker pedometer, a valid and reliable physical activity monitor.⁴⁵ For 1 week, participants wore the pedometer on their dominant hip during the day and recorded the number of steps daily in an activity diary, which was used to calculate a 7-day average of the number of steps per day taken. When a participant returned her activity diary with missing data, she was asked to start a new diary and wear the pedometer for another week. One hundred percent of women returned diaries with counts for at least 6 days.

Neighborhood Environment. An environmental questionnaire with 52 self-report items was developed to assess respondents' perception of the convenience, safety, aesthetics, and overall quality of their neighborhood surroundings for walking. The validity of the environmental questionnaire is currently being examined. The present study uses 14 items that measured the convenience of walking to

different types of destinations in the neighborhood and 1 item measuring the overall quality of the neighborhood surroundings for walking.

Participants were asked how much time it took to walk from home to 13 destinations (a biking or walking trail; bus stop; café or coffee shop; church or other religious institution; community center; convenience, deli, or grocery store; department, discount, or hardware store; doctor's office; library; park; post office; restaurant, pub, or bar; and work) and the frequency with which they made walking trips to each destination. Participants were also asked—"Are there any other destinations that you walk to regularly?"—and if so, the frequency of walking trips to those destinations. Fewer than 5% of participants reported walking to work, their doctor's office, and all written-in destinations; therefore, these destinations were excluded from analysis, leaving a total of 11 commonly walked destinations.

Based on the participants' responses, which indicated that they rarely walked to destinations more than 20 minutes away, destinations within 20 minutes were considered within walking distance for this cohort. The sum of commonly walked to destinations within walking distance provided a convenience score, ranging from 0 to 11. The number of walking trips per month to any of the 11 commonly walked to destinations was summed to provide an estimate of the total walking trips to these destinations per month.

Participants were also asked to rate the overall quality of their neighborhood surroundings for walking as poor, fair, good, or excellent as a global neighborhood walkability rating.

Demographics. Weight and height were measured in the clinic by trained staff, and body mass index was calculated (kg/m).² Employment or volunteer work, whether participants lived alone, cigarette smoking, alcohol consumption, walking limitations due to health or physical difficulty, perceived health status, and history of disease were assessed by questionnaire.

Characteristics of participants' neighborhoods were obtained from the 2000 U.S. Census and 2000 U.S. Census estimates^{46,47} after linking participants' home addresses to Census block-groups: subdivisions of U.S. Census tracts containing an average of 1000 people that act as proxies for neighborhoods. Descriptors from the Census included urban/suburban/rural status, median home value, median income, race, education, employment, status of housing units, and a crime index. The crime index is based on the national crime rate set at 100, such that a value of 10 equals one tenth of the average national crime rate, whereas a value of 300 equals three times the average national crime rate.⁴⁸

Analysis

The agreement between the pedometer and physical activity from the questionnaire was examined using the Kendall correlation to test the concordance of the objective and subjective physical activity measures.

The relationship between whether each destination was within walking distance of the home and physical activity level was examined using the Wilcoxon rank sum test. The Spearman rank order correlation coefficient was used to measure the association of physical activity levels and the convenience score. In addition, the convenience score was divided into a categorical variable based on a scatter plot, which demonstrated no increase in activity after two or more destinations were within walking distance (hence, categories are no destinations, one destination, and two or more destinations). The Jonckheere-Terpstra test for trend was performed to test the relationship between (1) convenience score category and physical activity levels, (2) neighborhood walkability rating and physical activity levels, and (3) convenience score and neighborhood walkability rating.

Analyses were also performed with exclusion of those who reported walking limitations ($n = 17$), as well as by stratifying participants by their treatment group in the 1982 to 1985 walking intervention (intervention or control). Data analyses were conducted

using Statistical Analysis Software, version 8.1 (SAS Institute Inc., Cary, North Carolina).

RESULTS

Participant Characteristics

Characteristics of study participants and nonparticipants (women who completed some part of the 1999 follow-up but did not participate in the current effort) are shown in Table 1. There were no significant differences between participants and nonparticipants in age, BMI, race, whether participants lived alone, satisfaction with health, smoking status, alcohol consumption, walking limitations, or prevalence of chronic conditions (Table 1). However, women in the current analysis reported significantly more total activity (median = 1246 [25th percentile: 554, 75th percentile: 2327] kcal/week versus 415 [208, 1558] kcal/week, $p < .01$) and were more likely to work or volunteer (71.8% vs. 48.7%, $p < .01$) than those who did not complete all measures.

The age of participants was 74.2 ± 4.2 (mean \pm SD) years. Participants were generally healthy, with 85.5% reporting satisfaction with their health, and only 5.4% reporting that walking was limited because of physical difficulty or health.

Physical Activity

Participants had a median of 5285 steps/d, as determined by pedometer, and reported a median of 1246 kcal/wk from total activity, as determined by questionnaire (Table 1). Walking was by far the most popular activity reported, with 77.9% of participants reporting walking in the last year, and an average of $55.5\% \pm 37.4\%$ of total kcals expended in physical activity attributed to walking. However, of the women who reported some type of physical activity (92.6%), 16.0% reported no walking, whereas 25.4% reported walking only; hence, there was a substantial variance in how much walking influenced total physical activity levels.

Walking and total physical activity measured by questionnaire were significantly, although not strongly, correlated with the pedometer (ques-

tionnaire-walking and pedometer: $\tau = .29, p < .01$; questionnaire-total activity and pedometer: $\tau = .28, p < .01$), implying that subjective and objective physical activity measures were 1.82 and 1.78 times, respectively, more likely to be concordant than discordant.

Neighborhood Environment

Addresses of 147 of the 149 (99%) participants were successfully linked to a total of 128 distinct U.S. Census block-groups. Neighborhood characteristics based on block-groups are presented in Table 2. The majority of participants lived in suburban or urban neighborhoods, where residents were predominantly Caucasian, white-collar workers, home owners, and high school graduates or greater (Table 2). The median crime index was 39, which translates to a median crime rate that is 39% of the national average crime rate. However, 32% of neighborhoods had a crime rate greater than the average national crime rate.

The percentage of participants that lived within walking distance of each destination and the percentage that walked to each destination at least once a month is presented in Table 3. Between 20% and 78% of participants were within walking distance of each destination, with the majority within walking distance of a bus stop; café or coffee shop; convenience, deli, or grocery store; or restaurant, pub, or bar. Half of the participants lived within walking distance to at least four destinations (25th percentile: 2, 75th percentile: 7). However, 14% of the participants did not live within walking distance of any of the commonly walked to destinations. The convenience, deli, or grocery store was the most popular destination for women to walk to at least once a month (26%), followed by the park (20%).

The median number of walking trips per month to each destination for those who reported walking to that destination at least once a month is also presented in Table 3. For the 59.1% of participants who reported walking to at least one destination at least once a month, the median walking trips per month was

Table 1
Characteristics of Study Participants and Nonparticipants

	Study Participants n = 149	Nonparticipants n = 39
Demographics	Mean (SD)	Mean (SD)
Age (years)	74.2 (4.2)	74.7 (4.7)
	% (N)	% (N)
Overweight (BMI \geq 27.3 kg/m ²)	37.6 (56)	54.5 (12)*
Race Caucasian	100 (149)	100 (39)
Work or volunteer	71.8 (107)	48.7 (19)†
Live alone	31.5 (47)	33.3 (13)
Health Status	% (n)	% (n)
Satisfied with health	85.2 (127)	76.9 (30)
Current smoker	6.0 (9)	0 (0)
Drinks \geq 1 alcoholic drink per week	56.4 (84)	59.0 (23)
Walking limited because of physical difficulty or health	5.4 (8)	7.7 (3)
Epilepsy, multiple sclerosis, or Parkinson's disease	2.0 (3)	2.6 (1)
Liver disease	1.3 (2)	0 (0)
Lung disease	10.7 (16)	15.4 (6)
Arthritis	60.4 (09)	64.1 (25)
Diabetes	7.4 (11)	5.1 (2)
Heart disease	9.4 (14)	12.8 (5)
Stroke	0.7 (1)	2.6 (1)
Physical Activity	Median (25th, 75th percentile)	Median (25th, 75th percentile)
Pedometer (steps/d)	5285 (3281, 7212)	Not available
Questionnaire—total walking (kcal/wk)	606 (139, 1246)	312 (0, 623)‡
Questionnaire—total activity (kcal/wk)	1246 (554, 2327)	415 (208, 1558)‡

* n = 22.

† Fisher's exact test, $p < 0.05$.

‡ Wilcoxon rank sum test, $p < 0.05$.

Table 2
Neighborhood Characteristics of Participants According to U.S. Census Block-Groups, n = 147

Neighborhood Characteristic	% (n)
Urban/urban fringe	47.6 (70)
Suburban	39.5 (58)
Exurban/rural	12.9 (19)
	Median (25th, 75th percentile)
Median home value (\$)	90,137 (67,077, 127,128)
Median income (\$)	41,747 (34,121, 51,363)
% Caucasian	94.7 (89.3, 97.1)
% High school degree or greater	91.1 (85.4, 95.0)
% White-collar worker	70.1 (60.5, 77.5)
% Unemployed	4.4 (4.3, 4.6)
% Owner-occupied homes	73.0 (42.1, 87.6)
% Vacant homes	4.4 (2.7, 7.4)
% Family-occupied homes	65.7 (49.6, 75.4)
Total crime index	39 (15, 148)

Table 3
Accessibility and Popularity of Walking Destinations

Destination	Women Within Walking Distance of Destination* (n = 149)	Women Who Walk to Destination at Least Once per Month† (n = 149)	No. Walking Trips per Month to Destination‡
	% (N)	% (N)	Median (25th, 75th percentile)
Biking or walking trail	25.5 (38)	11.4 (17)	8 (1, 16)
Bus stop	77.9 (116)	11.4 (17)	3 (1, 8)
Café or coffee shop	55.0 (82)	8.7 (13)	1 (1, 4)
Church or other religious institution	45.6 (68)	14.1 (21)	4 (1, 8)
Community center	30.9 (46)	9.4 (14)	6 (1, 8)
Convenience, deli, or grocery store	59.7 (89)	25.5 (38)	4 (1, 4)
Department, discount, or hardware store	20.1 (30)	8.7 (13)	4 (2, 4)
Library	30.2 (45)	12.1 (18)	3 (1, 4)
Park	46.3 (69)	20.1 (30)	4 (1, 16)
Post office	33.6 (50)	14.1 (21)	2 (1, 4)
Restaurant, pub, or bar	52.4 (78)	17.5 (26)	4 (1, 8)
Any above destination	85.6 (128)	59.1 (88)	12 (4, 28)

* Women who report designated destination is within a 20-minute walk of home.

† Women who report walking to the designated destination at least once a month.

‡ Number of walking trips per month to the designated destination for n = women who report walking to the designated destination at least once a month.

12 (25th percentile: 4, 75th percentile: 28), or approximately 3 trips/wk.

The majority of participants gave a favorable neighborhood walkability rating, with 31.1% rating excellent, 41.9% rating good, 16.2% rating fair, and 10.8% rating poor.

Commonly Walked Destinations and Physical Activity

The relationships between living within walking distance to each destination and physical activity levels, determined by pedometer and questionnaire, are shown in Table 4. Women who lived within walking distance to a biking or walking trail; department, discount, or hardware store; or park had significantly higher pedometer readings than women who did not. Although not statistically significant, walking and total physical activity levels measured by questionnaire were also higher for those who lived within walking distance to these destinations than those who did not. Living within walking distance to a bus stop; café or coffee shop; church, synagogue, or other religious institution; community center;

convenience, deli, or grocery store; library; post office; or restaurant, bar, or pub was not significantly related to any physical activity measures.

Convenience Score and Physical Activity

The convenience score was significantly, though not strongly, correlated with the number of steps measured by the pedometer ($r = .25$, $p < .01$), activity from walking reported in the questionnaire ($r = .17$, $p = .04$), and total activity reported in the questionnaire ($r = .16$, $p = .05$). There was also a significant trend between the grouped convenience score (0, 1, 2+ destinations) and activity levels, such that the median walking and total physical activity levels measured by pedometer and questionnaire more than doubled as participants reported being able to walk from zero to two or more destinations from home (Table 5).

Neighborhood Rating, Physical Activity, and Convenience Score

Participants' neighborhood walkability rating was significantly related to walking and physical activity levels

measured objectively and subjectively. As the neighborhood walkability rating improved, the pedometer reading was higher, and walking and total physical activity levels measured by questionnaire were higher (Table 6). There was also a significant trend between participants' neighborhood walkability rating and the convenience score. Thus, neighborhood walkability rating improved as the number of destinations within walking distance of home increased (Table 6).

Additional Analysis

When women who reported walking limitations (n = 17) were excluded from the analyses, results did not differ (data not shown), so they were included in the final analyses. In addition, when analysis was stratified by assignment to the intervention or control group from the original walking intervention (1982–1985), results remained the same (data not shown).

DISCUSSION

A primary focus of this study was to examine the associations between convenience of walking to destinations from the home and physical activity levels, measured both objectively and subjectively. The neighborhood convenience score, the sum of destinations within walking distance of the home, was positively associated with both walking and total physical activity levels, measured by pedometer and questionnaire. However, the association became more pronounced when the convenience score was divided into categories based on a scatter plot, which demonstrated no increase in activity after two or more destinations were within walking distance (hence, categories were zero destinations, one destination, and two or more destinations). This suggests a threshold effect such that physical activity increased as the number of destinations within walking distance increased from zero to one to two and then remained constant. Whether the same threshold would exist in other populations is unclear and should be investigated in future studies.

Table 4
Physical Activity Levels of Women Who Do and Don't Live Within Walking Distance to Each Destination, n = 149

Destination	n	Pedometer (steps/d) Median (25th, 75th)	Questionnaire [Median (25th, 75th)]	
			Walking (kcal/wk)	Total Activity (kcal/wk)
Biking or walking trail				
Yes	38	6797 (515, 8331)	692 (215, 1246)	1517 (785, 2285)
No	103	4908 (3060, 6728)	519 (104, 1246)	1246 (554, 2354)
<i>p</i> *		0.0018	0.3767	0.2636
Bus stop				
Yes	116	5494 (3436, 7265)	623 (139, 1240)	1246 (640, 2389)
No	27	5105 (3610, 7786)	623 (138, 1246)	1344 (646, 2492)
<i>p</i> *		0.7751	0.8040	0.6339
Café or coffee shop				
Yes	82	5657 (4021, 7588)	623 (116, 1246)	1281 (554, 2492)
No	59	5105 (2858, 7319)	519 (138, 1246)	1246 (658, 2215)
<i>p</i> *		0.1785	0.7030	0.8364
Church, synagogue, or religious institution				
Yes	68	5134 (3724, 6921)	669 (199, 1240)	1240 (692, 2279)
No	74	5695 (3244, 7747)	512 (138, 1246)	1341 (623, 2469)
<i>p</i> *		0.4823	0.3246	0.7552
Community center				
Yes	46	5148 (3449, 7660)	623 (138, 1168)	1454 (692, 2492)
No	93	5694 (3677, 7319)	554 (138, 2356)	1235 (623, 2327)
<i>p</i> *		0.7197	0.7352	0.4840
Convenience, deli, or grocery store				
Yes	89	5732 (3859, 7212)	692 (215, 1246)	1442 (692, 2354)
No	54	5084 (2865, 7576)	467 (69, 865)	1050 (623, 2469)
<i>p</i> *		0.3203	0.0567	0.4145
Department, discount, or hardware store				
Yes	30	6808 (5871, 8420)	658 (277, 1454)	1794 (739, 3000)
No	111	5015 (3060, 7021)	623 (138, 1246)	1168 (623, 2215)
<i>p</i> *		0.0022	0.3206	0.0722
Library				
Yes	45	5908 (4230, 8150)	880 (277, 1246)	1339 (785, 2539)
No	97	5116 (3281, 6889)	623 (138, 1246)	1062 (623, 2273)
<i>p</i> *		0.1006	0.3601	0.3518
Park				
Yes	69	6075 (4594, 8150)	692 (173, 1454)	1344 (692, 2539)
No	75	4802 (2908, 6305)	519 (139, 1235)	1235 (531, 2273)
<i>p</i> *		0.0044	0.2381	0.3729
Post office				
Yes	50	5899 (3755, 8034)	623 (242, 1246)	1292 (692, 2723)
No	92	5132 (3225, 7051)	614 (138, 1246)	1246 (635, 2244)
<i>p</i> *		0.1405	0.3372	0.4038
Restaurant, bar, or pub				
Yes	78	5287 (3616, 7114)	623 (92, 1050)	1390 (623, 2469)
No	64	5580 (3243, 7591.8)	623 (179, 1246)	1246 (652, 2215)
<i>p</i> *		0.9218	0.4293	0.7233

* Wilcoxon rank sum test.

These results confirm the findings of other researchers who have studied the relationship between various measures of convenience of destinations or opportunities for activity in the neighborhood environment and physical activity.^{13,14,49-51} However, two studies assessed the association of convenience of destinations (measured by distance to or density of several business destinations) with the frequency of walks to commercial areas, rather than total walking or physical activity levels^{14,49}; one study only used three destinations in the measure of convenience (shops, park or beach, and biking trail),¹³ and two studies asked participants only about opportunities in the neighborhood to be active without describing the types of opportunities.^{50,51} Therefore, this study expands on past research by including both a convenience measure made up of several commonly walked to destinations and physical activity measures that measure walking and total activity levels.

Living within walking distance of several specific types of destinations was also significantly related to physical activity levels in this study. In particular, women within walking distance of a park; biking or walking trail; or department, discount, or hardware store had significantly higher pedometer readings than women who did not. In addition, the relationship between living within walking distance to these destinations and walking and total physical activity levels measured by questionnaire were in the expected direction, but the relationship was not statistically significant. This discrepancy could be due to the questionnaire's insensitivity to activity or walking not specifically done for exercise,⁵²⁻⁵⁵ limitations due to recall bias,^{56,57} or both. Therefore, our findings identify a strength of this study and point to the importance of using objective measures of physical activity in this line of research.

Findings that the park^{6,10} and biking or walking trail^{5,6,10} are related to activity are consistent with past research. However, the relationship between proximity to department, discount, or hardware stores and physical activity has not been measured in

Table 5
Number of Destinations Within Walking Distance by Three Measures of Physical Activity, n = 149

Physical Activity Measure	No. of Destinations Within Walking Distance [Median (25th, 75th percentile)]			p*
	0 (n = 14)	1 (n = 15)	2–11 (n = 120)	
Pedometer (steps/d)	2745 (1038, 4382)	3281 (2449, 6801)	5714 (3940, 7703)	<0.0001
Questionnaire—walking (kcal/wk)	52 (0, 415)	139 (0, 831)	623 (196, 315)	0.0005
Questionnaire—total activity (kcal/wk)	241 (0, 1004)	995 (554, 1869)	1448 (692, 2533)	0.0002

* Jonckheere-Terpstra trend test.

Table 6
Neighborhood Walkability Rating by Three Measures of Physical Activity and Convenience of Destinations, n = 149

Physical activity measure [median (25th, 75th percentile)]	Neighborhood Rating				p*
	Poor (n = 16)	Fair (n = 24)	Good (n = 62)	Excellent (n = 46)	
Pedometer (steps/d)	3376 (2449, 4961)	4258 (22532, 6812)	5377 (3449, 6801)	6349 (4877, 8749)	0.0008
Questionnaire—walking (kcal/wk)	139 (0, 519)	363.5 (0, 1000)	623 (176, 1246)	692 (415, 1454)	0.0077
Questionnaire—total activity (kcal/wk)	612 (65, 1015)	1396 (640, 2308)	1246 (415, 2327)	1399 (854, 2908)	0.0016
Convenience of destinations [median (25th, 75th percentile)]					
No. of destinations within walking distance	1.5 (.5, 3.5)	4.5 (1, 7)	5 (3, 8)	6 (4, 8)	0.0005

* Jonckheere-Terpstra trend test.

other studies. The closest measure, used in a recent study by Giles-Corti and colleagues, failed to find a relationship between having a shop and footpath nearby and exercising as recommended.⁵⁸ Whether the discrepancy in findings between Giles-Corti and the current results comes from the difference in definition of shop, assessment of physical activity, or the population under investigation is unclear.

Participants' walkability rating was significantly related to all walking and activity measures: the higher the neighborhood walkability rating, the higher the pedometer reading and the higher the reported walking and total physical activity levels. For the most part, these results conflict with the findings of previous studies investigating an association between a comprehensive measure of the neighborhood environment and physical activity; two studies found no association,^{8,17} one study found no association in women but a significant asso-

ciation in men,⁵⁹ and one study found only a weak association (standardized $r = .05$).¹⁸ However, this study's comprehensive measure of neighborhood environment asked participants to give a global neighborhood walkability rating, representing a purely subjective impression without reference to specific characteristics, whereas the other studies used aggregate measures of the neighborhood environment made up of several specific characteristics of the environment they felt could influence physical activity. Therefore, it is possible that the other comprehensive measures of neighborhood environment did not sufficiently capture the aspects of the neighborhood environment that are related to physical activity.

The positive association between the neighborhood convenience score and participants' overall rating of their neighborhood surroundings for walking suggests their respective relationships with physical activity are

not unrelated. In other words, this relationship suggests that participants' perception of the quality of the neighborhood surroundings for walking is associated with the convenience of destinations in their neighborhood. This finding is in agreement with the findings from the West of Scotland Twenty-07 Study, which found a significant relationship between the sum of amenities within walking distance of participants' homes and participants' perception of area reputation, area satisfaction, and overall area assessment.⁶⁰

One limitation of this study is that because it relied on an existing cohort originally intended to study a different outcome, it was not powered for several of the analyses in this paper. Our small sample size might have limited our power to find significant differences. In addition, the cohort consisted of a relatively homogeneous sample of women. Participants were fairly healthy older Caucasian women, who for the most

part lived in neighborhoods of middle to high socioeconomic status and who perceived their overall neighborhood surroundings for walking to be good or excellent. Therefore, generalizations from these results are limited. However, the similarity of the participants can also be viewed as a strength of the study design. With a homogeneous sample, the number of potential confounding factors, such as age, race, or socioeconomic status, were reduced.

Another limitation of this study is that we used the self-report walking patterns of participants to define "within walking distance." Although this method allowed us to find an accurate and meaningful definition for our study population, the definition (within a 20-minute walk) might not be the appropriate definition of "within walking distance" in other populations. In addition, it is likely that women who had walked to destinations in the past were more accurately able to report the correct walking time to destinations from their home, or that women who walked more were more likely to know where the closest destinations to their home were. If either of these are the case, the relationship between convenience of destinations and walking could be somewhat inflated.

In the present study, convenience of destinations and quality of neighborhood surroundings for walking were related to walking and total physical activity levels in a sample of older women. These results suggest that future interventions aimed at increasing the physical activity levels of older women might need to address the environment to accomplish this goal. Specifically, creating environments in which older women can make utilitarian walking trips from home might be effective. Additional research could help determine what specific aspects of the neighborhood surroundings, beyond convenience of destinations, are related to physical activity levels in this population. In addition, there is a need for similar research to be conducted in a more diverse group of individuals so that the effects of these environmental

factors can be better understood in the population at large.

So What? Implications for Health Promotion Research

This study indicates that the ability to make utilitarian walking trips from home and the perception of having favorable neighborhood surroundings for walking are associated with increased physical activity in older women. In addition, these findings indicate that a significant relationship between environmental measures and physical activity could go undetected if only subjective measures of activity are used.

If these assertions hold true, additional research is needed to determine (1) what other aspects of the neighborhood surroundings for walking are related to physical activity levels of older women and (2) whether the same relationships between the neighborhood environment and physical activity hold in other populations. In addition, a new goal of this area of research should be to use reliable and valid objective measures of physical activity whenever possible to assure accuracy and comparability of results.

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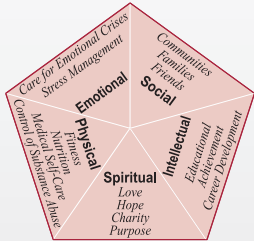
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