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Neighborhood built and social environment and meeting physical activity recommendations among mid to older adults with joint pain

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ABSTRACT

Arthritis is a leading cause of disability in the United States, with the most efficacious treatments being physical activity (PA). Arthritis patients are less likely to meet PA recommendations and the neighborhood environment may play a role. This study examines the effect of neighborhood walkability and social cohesion on PA among arthritis patients in a sample of US adults. This cross-sectional study used 2015 National Health Interview Survey data. Eligible participants were age ≥45 years, had arthritis, recent leg-joint pain and complete data. Walkability was based on 6 questions regarding amenities and destinations that promote walking. Social cohesion was based on 4 validated questions. Meeting PA was defined as 150 min/week. Chi-squared testing and logistic regression determined associations between neighborhood environment and PA, including interaction between social cohesion and walkability. The final unweighted sample included 3,826 participants with mean age 64.6 years (SE = 0.26), 61.8% female and 78.1% non-Hispanic White. In adjusted, weighted analysis, not, slightly, and moderately-walkable neighborhoods all had lower odds of meeting PA recommendations verses highly-walkable neighborhood (OR = 0.61[95% CI 0.41–0.92], OR = 0.65[95% CI 0.50–0.85], OR = 0.75[95% CI 0.59–0.97], respectively). Social cohesion was independently associated with decreased odds of meeting PA guidelines (p = 0.003). No interaction with walkability was found (p = 0.405). Less than a highly-walkable neighborhood and lower social cohesion were independently associated with decreased odds of meeting PA recommendations among adults with arthritis and recent joint pain. Since walking is one of the most effective treatments for arthritis, clinicians should be sensitive to barriers patients may perceive to walking.

1. Introduction

Arthritis and musculoskeletal pain are among the most common causes of disability in the United States [1]. Further, data suggest that these conditions are on the rise [2]. Arthritis and musculoskeletal pain encompass a relatively broad group of painful conditions, such as osteoarthritis (OA), fibromyalgia (FM), and rheumatoid arthritis (RA). Although the arsenal of pharmacologic treatments for arthritic conditions is large, the data supporting the efficacy of many of these treatments are lacking. Some data even implicate these medications as potential health hazards [3–5]. Opioids, for instance, are commonly prescribed in arthritis but associated with many poor outcomes [6]. In the age of the opioid epidemic, it is imperative that we develop and implement alternatives that are economical, effective, and without harm.

Non-pharmacologic interventions, particularly physical activity, are by far the most effective in treating many musculoskeletal pain conditions [7–9]. Strong evidence suggests OA patients experience decreased pain and stiffness, as well as increases in physical function with physical activity such as walking [9,10]. However, many patients with these musculoskeletal conditions do not meet physical activity recommendations [11]. The reasons why individuals with these conditions do not meet physical activity recommendations, however, remain unclear [11–14]. Other studies have found that attributes of the patient's built environment may facilitate physical activity, especially as walking in their neighborhood would be an easy, low-cost solution to improving patient outcomes [15].

Two commonly identified aspects of neighborhood characteristics are the physical environment, such as walkability, and the social environment, e.g. neighborhood cohesion [16]. Each appears to

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independently influence physical activity in mid to older adults, many of whom may have arthritis [17,18]. Their results suggested that low social cohesion and perceived poor walkability were associated with worse physical functioning and disability, however these samples were restricted to particular geographic areas (North Carolina and Belgium). Further, Van Holle *et al.* identified social cohesion as modifying the effect of walkability, where some older adults walked despite low walkability when social cohesion was high [18]. Since alterations to the physical environment may not always be feasible, enhancing the social environment may present another opportunity to improve physical activity. This study examines the extent to which social cohesion and perceived neighborhood walkability are associated with physical activity and whether social cohesion modifies the effect of walkability on physical activity among mid to older adults with arthritis diagnosis and lower extremity joint pain.

2. Methods

2.1. Study population

This cross-sectional study used self-reported data from the 2015 National Health Interview Survey (NHIS), which are collected through in-person survey by trained representatives from the United States Census Bureau. These data are collected using complex sampling techniques to allow for representation of the United States population. The 2015 annual response rate was approximately 70.1% of eligible households [19]. To be included in this study, participants were at least 45 years old with self-reported doctor-diagnosed arthritis, rheumatoid arthritis, fibromyalgia, gout or Lupus with pain in knee, hip or ankle in the last 30 days at the time of the survey, resulting in a target population of 4690 participants. Self-report of these conditions is considered accurate when compared to claims data [20,21]. Participants were limited to those at least 45 years of age to be consistent with the literature regarding the beginning of symptoms, especially of osteoarthritis [22,23]. Lower extremity joint pain was chosen as these are conceptually the joints that would be most limiting to walking, but also likely benefit the most from walking. A complete case analysis was undertaken to minimize bias, thus patients were excluded if they had incomplete data on demographics, social cohesion, walkability, physical activity, or covariates. After removing participants with missing variables, the eligible study population of 4690 was reduced to a final analytic sample of 3826 participants (Fig. 1).

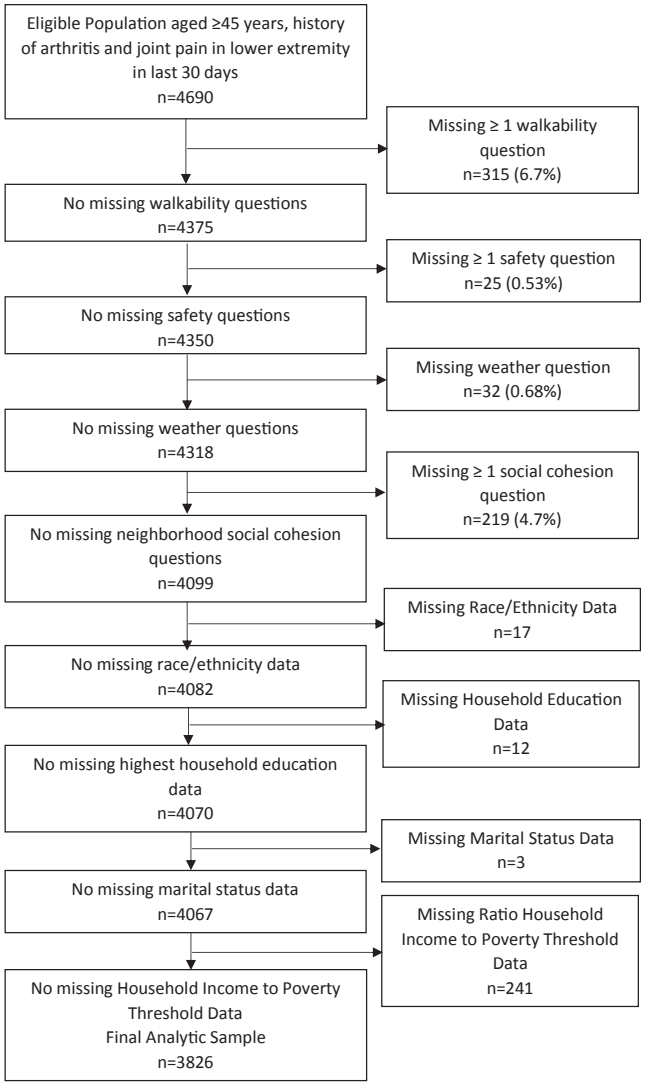

Fig. 1. Flow of inclusion complete case analysis.

Table 1
Content of questions for walkability and social cohesion.

Walkability "Where you live…"
"…are there roads, sidewalks, paths or trails where you can walk?"
"…are there shops, stores, or markets that you can walk to?"
"…are there bus or transit stops that you can walk to?"
"…are there places like movies, libraries, or churches that you can walk to?"
"…are there places that you can walk to that help you relax, clear your mind, and reduce stress?"
"…do most streets have sidewalks?"
Social Cohesion "How much do you agree with the following statements about your neighborhood?"
"People in this neighborhood can be trusted."
"People in this neighborhood help each other out."
"This is a close-knit neighborhood."
"There are people I can count on in this neighborhood."

2.2. Exposures of interest

This study focused on perceived walkability and perceived neighborhood social cohesion. Perceived walkability was ascertained from six questions pertaining to the participant's feelings about their neighborhood. These questions centered on destinations to which participants could walk, as well as amenities to allow for walking (see Table 1). These questions were answered as either "yes" or "no." The number of "yes" answers were tallied up for a maximum total of 6 and a minimum of 0, then categorized as "not walkable" (0), "slightly walkable" (1–2), "moderately walkable" (3–4) and "highly walkable" (5–6). Internal validity of questions was assessed via Kuder-Richardson-20 resulting in a correlation of 0.793. Perceived social cohesion was based on four questions regarding the social nature of the neighborhood (Table 1).

These questions were answered on a Likert scale ranging from "strongly agree" (1) to "strongly disagree" (4). These answers were tallied up with a maximum score of 16 (low social cohesion) and minimum score of four (high social cohesion). These totals were then quartiled within the entire participant population. The use of these questions in this manner was previously described by Yi et al in a national sample of NHIS participants [24]. Internal validity was assessed via Cronbach's Alpha. A value of 0.893 was determined, supporting high internal validity.

2.3. Outcome of interest

All participants were asked a series of questions regarding their activity. These were then quantified into minutes/week of moderate or vigorous activity. This was converted into a bivariate construct of either meeting physical activity recommendations or not. Participants were

categorized as meeting PA recommendations if they had greater than or equal to 150 min of PA and as not meeting if any number less than 150 min [25]. No delineation was available regarding type of activity. The questions in the NHIS data reliably measure physical activity [26].

2.4. Covariates

All covariates were previously found to be associated with the likelihood of meeting physical activity recommendations [14,27–31]. Variables included in this analysis included gender, age, race/ethnicity, household highest educational attainment, household income-to-poverty threshold ratio, marital status, perceived neighborhood safety, length of time in the neighborhood, and weather. Age was categorized as 45–54 years, 55–64 years, 65–74 years, and age 85 plus. Race/Ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic/Latino, or Other. Highest household educational attainment was categorized as less than high school diploma through diploma or GED, some college through bachelors or associates degree, and masters and above. Income-to-poverty ratio was categorized as less than 1.00 of threshold, 1–1.99 of threshold, 2.00–3.99 of threshold, and less than 4.00 of the threshold. Marital status was categorized as never married, widowed/separated/divorced, or married/living with partner. Perceived neighborhood safety was determined through answers to three questions regarding participant perception of whether traffic, animals, or crime make them feel it is unsafe to walk. The answers to these questions were “yes” or “no”. Participants answers were categorized as never (0 affirmative answers), low (1 affirmative answer), moderate (2 affirmative answers), or high (3 affirmative answers). These questions are similar to those used in other studies assessing safety [17,32]. A single question asked how frequently weather served as a barrier to walking. The answers were categorized as never, a little of the time, some of the time, most of the time, or all of the time. Length of residence in the neighborhood was included in the statistical models as this may affect the knowledge a participant has about their neighborhood, or their opportunity interact with neighbors. Length of time was categorized as less than 1 year, 1–3 years, 4–10 years, 11–20 years, and greater than 20 years.

2.5. Analysis

All analyses were weighted to account for complex survey sampling. All analyses used the entire dataset with a domain statement and inclusion variable in proc survey commands or additional layer in proc surveyfreq to correctly account for subpopulation analysis and preserve the integrity of the weights [33]. Unadjusted associations between covariates and perceived walkability and between covariates and meeting physical activity recommendations were tested using chi-square tests. Results were considered statistically significant at $p < 0.05$. Adjusted relationships between exposures, covariates, and outcomes were assessed using binomial logistic regression models to ascertain odds of meeting physical activity recommendations. If a covariate was found to be associated with either perceived walkability or meeting physical activity recommendations, it was included in the logistic regression model. To assess whether social cohesion modified the association between walkability and meeting physical activity recommendations, an interaction term was added to the unadjusted model including only perceived walkability, social cohesion, and meeting PA recommendations. To investigate for possible multicollinearity among variables, correlation coefficients were calculated between all variables as well as multicollinearity diagnostics, in particular variance inflation factor (VIF). All data were analyzed using SAS v9.4.

Table 2
Univariate associations exposure, covariates and outcome with unweighted frequency and weight percent.

Variables	Meeting PA Recommendations n = 1128	Not Meeting PA Recommendations n = 2698	P-Value
Walkability			< 0.001
Not Walkable	59 (6.84)	284 (11.5)	
Slightly Walkable	308 (27.2)	866 (33.7)	
Moderately Walkable	293 (27.7)	700 (26.0)	
Highly Walkable	468 (38.2)	848 (28.7)	
Age			< 0.001
45–54	221 (23.0)	447 (19.3)	
55–64	353 (33.3)	788 (31.5)	
65–74	370 (29.3)	749 (26.2)	
75–84	145 (11.9)	485 (15.9)	
85 +	39 (2.51)	229 (7.10)	
Sex			0.018
Male	460 (42.0)	885 (36.6)	
Female	668 (58.0)	1813 (63.4)	
Race/Ethnicity			0.007
Non-Hispanic White	876 (80.6)	1926 (77.0)	
Non-Hispanic Black	128 (8.61)	433 (12.9)	
Other	47 (5.00)	90 (3.43)	
Hispanic	77 (5.75)	249 (6.71)	
Education			< 0.001
HS Diploma/GED or less	244 (16.2)	1111 (36.8)	
Some College-AA/ Bachelors	615 (55.1)	1350 (52.1)	
Masters and Above	269 (28.7)	237 (11.1)	
Income to Poverty Threshold Ratio			< 0.001
< 1.00	111 (7.64)	528 (14.4)	
1.00–1.99	175 (12.9)	763 (25.0)	
2.00–3.99	316 (23.7)	786 (32.1)	
4.00 or More	526 (55.7)	621 (28.4)	
Marital Status			0.006
Married/Living with Partner	575 (65.1)	1166 (57.8)	
Widowed/ Divorced/ Separated	455 (29.3)	1276 (35.1)	
Never Married	98 (5.59)	256 (7.13)	
Perceived Social Cohesion			< 0.001
High	451 (40.2)	885 (33.0)	
High-Mid	298 (26.5)	597 (22.8)	
Low-Mid	211 (21.2)	618 (23.7)	
Low	168 (12.1)	598 (20.5)	
Safety			< 0.001
Never Barrier	729 (64.7)	1553 (58.8)	
Low Barrier	281 (26.2)	667 (25.2)	
Moderate Barrier	88 (6.33)	309 (10.8)	
High Barrier	30 (2.68)	169 (5.21)	
Weather As a Barrier			< 0.001
Almost Always	226 (18.6)	921 (33.2)	
Most of the Time	137 (11.0)	353 (14.3)	
Some of the Time	341 (32.2)	482 (18.0)	
A little of the Time	203 (19.4)	237 (8.37)	
Never	221 (18.9)	705 (26.2)	
Length of Time in Neighborhood			0.306
< 1 year	52 (4.34)	151 (5.34)	
1–3 years	123 (11.5)	337 (11.6)	
4–10 years	275 (24.2)	596 (20.6)	
11–20 years	245 (22.5)	564 (23.2)	
> 20 years	433 (37.3)	1050 (39.2)	

3. Results

3.1. Demographics

The final unweighted analytic sample consisted of 3826 participants. The average age was 64.6 years (SE = 0.26). The study population was 61.8% female and 78.1% non-Hispanic White. Among the study population, 30.7% achieved levels of activity consistent with PA recommendations (SE = 1.08).

3.2. Univariate analysis

Univariate analysis revealed that race/ethnicity, household income-to-poverty ratio, educational attainment, marital status, social cohesion, perceived safety, weather, and time living in the neighborhood were associated with perceived walkability (See Appendix 1).

Table 2 shows unadjusted associations between exposures of interest, covariates and meeting physical activity recommendations. All covariates, with the exception of length of time in the neighborhood were found to be associated with meeting physical activity recommendations (all $p < 0.05$). Given all variables were found to be associated with either the exposure or the outcome, all variables were included in the final logistic regression model. This included social cohesion, found to be independently associated with walkability ($p = 0.028$).

3.3. Multivariate analysis

Table 3 shows results of the logistic regression analysis for walkability and social cohesion. In unadjusted analysis, participants in not walkable and slightly walkable neighborhoods had 55% and 39% decreased odds of meeting physical activity recommendations compared to highly walkable neighborhoods (OR = 0.45 [95% CI = 0.31–0.64], OR = 0.61 [95% CI = 0.48–0.77], respectively). Moderately walkable perception was not statistically different from highly walkable (OR = 0.80 [95% CI = 0.63–1.02). In unadjusted analysis, Low and Low-Mid Social cohesion were also associated with decreased odds of meeting PA recommendations compared to high social cohesion (OR = 0.49 [95% CI = 0.36–0.65, OR = 0.74 [95% CI = 0.56–0.96], respectively). When adjusted for one another, they remains similarly associated with meeting PA recommendations ($p < 0.001$ for both) and relatively unchanged in separate models incorporating covariates. In an adjusted logistic regression, not walkable, slightly walkable, and moderately walkable groups were all less likely to meet physical activity recommendations compared to highly walkable perception (OR = 0.61 [95% CI = 0.41–0.92], OR = 0.65 [95% CI = 0.50–0.85], OR = 0.75 [95% CI = 0.59–0.97], respectively). Low and low-med perceived neighborhood social cohesion were independently associated with decreased odds of meeting recommendations verses high social cohesion (OR = 0.58 [95% CI = 0.43–0.78], OR = 0.71 [95% CI = 0.53–0.93], respectively).

3.4. Interaction analysis

The introduction of the social cohesion*walkability interaction term to the univariate model resulted in no significant effect modification by social cohesion on the effect of walkability on meeting PA recommendations ($p = 0.405$).

3.5. Sensitivity analysis

Sensitivity analyses were conducted to examine any risk of bias due to inclusion criteria, as well as multicollinearity. Examination of demographics between final population (n = 3826) and those removed for incomplete data (n = 863) revealed only one significant difference. The included population did tend to have a higher population of white members compared to those with incomplete data (data available upon request). Further, analysis for multicollinearity utilizing VIF demonstrated no multicollinearity (all VIF < 2.0). These data are available upon request.

4. Discussion

This study found that a highly walkable neighborhood and high social cohesion were independently associated with meeting physical activity recommendations. For clinicians, inquiry into a patient's perception of their neighborhood may allow for more focused counseling on topics that seem to matter most. Clinicians may instead be understanding of a poorly walkable neighborhood and direct the patient to other ways to be active. This may include local, affordable gyms within a reasonable distance from the patient's residence. A clinician's counseling on exercise has been shown to be effective in influencing patient activity [34]. In addition, community engagement around physical activity, such as walking groups or free community exercises classes may also boost activity in capitalizing on the potential impact of social cohesion and social support [35].

These data add to the continually growing landscape of evidence suggesting that high perceived walkability is associated with increases in physical activity [17,36–38]. Martin et al found similar results in a population of North Carolina residents with arthritis [17]. Maisel et al found similar results in a cohort of older adults in Erie County, New York [38]. This study extends these geographic areas assessed to the rest of the country, allowing for further generalizability. However, in contrast to the van Holle study, no effect modification was identified on the part of social cohesion [18]. This population was, on average younger, than the van Holle study. Older adults have been noted to be more heavily tied to their community than younger individuals, which

Table 3
Logistic regression models for odds of meeting PA recommendations.

	OR (95%CI)	p-value	OR* (95%CI)	p-value	aOR**(95%CI)	p-value	aOR***	p-value
Walkability		< 0.001		< 0.001		0.016		0.008
Not Walkable	0.45 (0.31–0.64)		0.43(0.30–0.61)		0.64(0.42–0.96)		0.61(0.41–0.92)	
Slightly Walkable	0.61 (0.48–0.77)		0.57(0.44–0.73)		0.67(0.52–0.87)		0.65(0.50–0.85)	
Moderate Walkable	0.80 (0.63–1.02)		0.78(0.62–0.99)		0.76(0.60–0.98)		0.75(0.59–0.97)	
High Walkable	1.00 (ref)		1.00 (ref)		1.00(ref)		1.00 (ref)	
Social Cohesion		< 0.001		< 0.001		0.005		0.003
Low	0.49 (0.36–0.65)		0.45(0.34–0.60)		0.60(0.45–0.81)		0.58(0.43–0.78)	
Low-Mid	0.74 (0.56–0.96)		0.69(0.53–0.90)		0.73(0.55–0.96)		0.71(0.53–0.93)	
High-Mid	0.96 (0.74–1.23)		0.90(0.69–1.16)		0.92(0.71–1.20)		0.90(0.69–1.17)	
High	1.00 (ref)		1.00(ref)		1.00(ref)		1.00(ref)	
Interaction Term				0.405				

*Model includes Walkability and social cohesion.
**Model includes Walkability and covariates or Social Cohesion and covariates.
***Model Includes Walkability, social cohesion, and covariates.

may explain why this effect was not found [39]. The mechanism of connection between neighborhood walkability perception and physical activity has yet to be fully explained, with causation particularly difficult to nail down [40]. However, a recent study assessed patients around the time of a move from a less walkable to a more walkable neighborhood and found that physical activity increased post-move [41]. Further, certain types of PA seem to be more strongly tied to walkability, particularly active transport [42]. This study offers a glimpse into how neighborhood environment seems to influence PA, with further attention warranted to the specific questions utilized to assess walkability and which seem to influence PA the most.

This study has several strengths, including a large, nationally-representative sample of the US population, valid physical activity data, adjustment for a large number of covariates and confounders, a high response rate, excellent measures of reliability for the scales created, as well as standardized collection of data. The walkability index used was also novel to this data set, as these questions regarding walkability were new to the NHIS in 2015 and only one study has examined them in any context [43]. This study also as several limitations. All data are self-reported, though evidence suggests these data are reliable [26,44]. Although walkability was the reported perception by the participants, perception of walkability is more likely to influence walking than objective measures [45]. Additionally, the creation of the walkability index may not fully capture the influence of particular elements of walkability that may vary by patient population, with older adults potentially being more influence by route attributes [46]. Further studies are warranted to examine which elements may be most predictive of physical activity, and thus have the most potential as public health targets. This study is also limited by the definition of arthritis as a wide array of self-reported chronic conditions, although previous studies have shown this to be a reliable measure [20]. In addition, the five conditions grouped together as arthritis all benefit from exercise. Further investigation in to each of these disease states may also yield disease-specific recommendations. This study was limited by the available variables in the NHIS data and the questions used to assess these variables, such as safety. The present study fails to establish causality, given its cross-sectional nature, but seems to add support to the notion that walkable perception may influence physical activity. Further, we are unable to distinguish particular type of activity engaged in for physical activity. This study is also limited by response bias resulting in a population that is disproportionately white. However, this is unfortunately common to these national data sets, but does warrant further investigation [47]. Finally, this study grapples with the directionality of the associations in that "walkers" may choose to live in walkable neighborhoods. In addition, meeting physical activity recommendations does not necessarily mean participants are doing so by walking in their neighborhood. However, older adults tend to do most of their walking within their neighborhood [32].

5. Conclusions

In this nationally-representative study of mid to older adults with arthritis and active joint pain, any perception less than a highly walkable neighborhood was associated with decreased odds of meeting physical activity recommendations. Low social cohesion was independently associated with decreased odds of meeting physical activity recommendations, as well. This study brings further understanding to the distinct contributions of built and social environment, illustrating their individual roles and the complexity of how neighborhoods affect health. Further studies examining which specific elements of neighborhoods may be most influential on physical activity and investigating the potential of augmentation of social ties to improve physical activity may bring further clarity to these associations.

CRediT authorship contribution statement

Sarah Gebauer: Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Writing - original draft. **Mario Schootman:** Methodology, Writing - review & editing, Supervision. **Hong Xian:** Methodology, Writing - review & editing, Supervision. **Pamela Xaverius:** Conceptualization, Methodology, Writing - review & editing, Supervision.

Appendix

Table A1
Distribution of covariates and univariate analysis by walkability perception group. Unweighted frequencies (weighted percent).

Demographics	Total Population n = 3826	Not Walkable n = 343	Low Walkable n = 1174	Moderate Walkable n = 993	Highly Walkable n = 1316	p-value
Age						0.096
45–54	668 (20.4)	40 (15.3)	168 (18.4)	179 (21.7)	281 (23.0)	
55–64	1141 (32.1)	107 (35.8)	350 (30.6)	291 (30.5)	393 (33.6)	
65–74	1119 (27.2)	101 (25.9)	342 (27.7)	285 (27.4)	391 (26.9)	
75–84	630 (14.6)	70 (16.1)	214 (16.6)	166 (15.3)	180 (11.6)	
85 +	268 (5.7)	25 (6.91)	100 (6.67)	72 (5.07)	71 (4.84)	
Sex						0.586
Male	1345 (38.2)	114 (34.9)	438 (39.6)	337 (38.1)	456 (38.0)	
Female	2481 (61.8)	229 (65.1)	736 (60.4)	656 (61.9)	860 (62.0)	
Race/Ethnicity						< 0.001
Non-Hispanic White	2802 (78.1)	274 (84.3)	990 (87.8)	725 (78.2)	813 (66.3)	
Non-Hispanic Black	561 (11.6)	46 (9.55)	116 (7.50)	144 (11.6)	255 (16.4)	
Other	137 (3.91)	6 (3.18)	22 (2.11)	37 (3.78)	72 (6.10)	
Hispanic	326 (6.42)	17 (2.97)	46 (2.66)	87 (6.42)	176 (11.3)	
Education						0.005
HS Diploma/GED or less	1355 (30.4)	167 (42.2)	434 (33.2)	329 (25.5)	425 (28.1)	
Some College-AA/Bachelors	1965 (53.0)	154 (47.2)	575 (50.6)	523 (55.8)	713 (55.0)	
Masters and Above	506 (16.5)	22 (10.6)	165 (16.2)	141 (18.7)	178 (16.9)	
Income to Poverty Threshold Ratio						< 0.001
< 1.00	639 (12.3)	58 (12.9)	161 (9.80)	159 (10.9)	261 (15.9)	
1.00–1.99	938 (21.3)	109 (31.2)	307 (23.0)	225 (17.2)	297 (19.8)	
2.00–3.99	1102 (29.5)	99 (25.5)	360 (32.2)	286 (30.3)	357 (27.5)	
4.00 or More	1147 (36.8)	77 (30.4)	346 (34.9)	323 (41.6)	401 (36.7)	

(*continued on next page*)

Table A1 (*continued*)

Demographics	Total Population n = 3826	Not Walkable n = 343	Low Walkable n = 1174	Moderate Walkable n = 993	Highly Walkable n = 1316	p-value
Marital Status						0.001
Married/Living with Partner	1741 (60.0)	163 (61.0)	610 (64.9)	439 (59.9)	529 (55.0)	
Widowed/Divorced/Separated	1731 (33.3)	161 (34.4)	500 (30.3)	458 (34.3)	612 (35.1)	
Never Married	354 (6.67)	19 (4.58)	64 (4.85)	96 (5.81)	175 (9.83)	
Perceived Social Cohesion						< 0.001
High	1336 (35.2)	138 (42.3)	492 (40.6)	325 (32.5)	381 (29.9)	
High-Mid	895 (23.9)	56 (15.1)	270 (23.9)	256 (27.1)	313 (24.1)	
Low-Mid	829 (22.9)	80 (25.9)	213 (19.7)	209 (21.8)	327 (26.2)	
Low	766 (17.9)	69 (16.7)	199 (15.8)	203 (18.6)	295 (19.8)	
Safety						< 0.001
Never Barrier	2282 (60.6)	145 (40.8)	677 (57.1)	591 (62.5)	869 (69.0)	
Low Barrier	948 (25.5)	115 (34.3)	329 (30.1)	240 (24.4)	264 (19.0)	
Moderate Barrier	397 (9.43)	49 (16.4)	115 (8.57)	100 (8.93)	133 (8.50)	
High Barrier	199 (4.43)	34 (8.47)	53 (4.22)	62 (4.23)	50 (3.53)	
Weather as a Barrier						< 0.001
Almost Always	1147 (28.7)	124 (35.2)	379 (31.7)	300 (29.1)	344 (23.2)	
Most of the Time	490 (13.3)	40 (12.5)	150 (14.5)	124 (12.6)	176 (12.8)	
Some of the Time	823 (22.4)	34 (10.0)	222 (20.1)	239 (25.9)	328 (25.6)	
A little of the Time	440 (11.7)	24 (6.08)	117 (10.2)	118 (11.4)	181 (14.5)	
Never	926 (24.0)	121 (36.2)	306 (23.5)	212 (21.1)	287 (22.9)	
Length of Time in Neighborhood						0.001
< 1 year	203 (5.03)	9 (2.30)	57 (4.75)	47 (4.06)	90 (7.01)	
1–3 years	460 (11.6)	30 (9.88)	122 (10.2)	121 (11.3)	187 (13.7)	
4–10 years	871 (21.7)	64 (19.2)	247 (20.4)	242 (23.0)	318 (22.8)	
11–20 years	809 (23.0)	64 (19.8)	239 (22.5)	221 (24.2)	285 (23.6)	
> 20 years	1483 (38.6)	176 (48.8)	509 (42.1)	362 (37.3)	436 (32.9)	

Table A2
Full results of logistic regression models for odds of meeting PA recommendations.

	OR	95% CI	p-value	aOR	95% CI	P-value
Walkability			< 0.001			0.008
Not Walkable	0.45	0.31–0.64		0.61	0.41–0.92	
Slightly Walkable	0.61	0.48–0.77		0.65	0.50–0.85	
Moderately Walkable	0.80	0.63–1.02		0.75	0.59–0.97	
Highly Walkable	1.00	Reference		1.00	Reference	
Age						0.020
45–54				1.00	Reference	
55–64				0.80	0.59–1.09	
65–74				0.83	0.61–1.12	
75–84				0.68	0.47–0.99	
85 +				0.36	0.19–0.67	
Sex						0.203
Male				1.00	Reference	
Female				0.87	0.69–1.08	
Race/Ethnicity						0.223
Non-Hispanic White				1.00	Reference	
Non-Hispanic Black				0.83	0.59–1.17	
Other				1.51	0.95–2.40	
Hispanic				1.07	0.71–1.62	
Education						< 0.001
HS Diploma/GED or less				0.34	0.24–0.49	
Some College-AA/Bachelors				0.60	0.44–0.82	
Masters and Above				1.00	Reference	
Income to Poverty Threshold Ratio						< 0.001
< 1.00				0.41	0.28–0.61	
1.00–1.99				0.42	0.31–0.56	
2.00–3.99				0.49	0.39–0.62	
4.00 or More				1.00	Reference	
Marital Status						0.039
Married/Living with Partner				1.00	Reference	
Widowed/Divorced/ Separated				1.35	1.07–1.70	
Never Married				1.12	0.73–1.71	
Perceived Social Cohesion						0.003
High				1.00	Reference	
High-Mid				0.90	0.69–1.17	
Low-Mid				0.71	0.53–0.93	
Low				0.58	0.43–0.78	

(*continued on next page*)

Table A2 (*continued*)

	OR	95% CI	p-value	aOR	95% CI	P-value
Safety						0.359
Never Barrier				1.00	Reference	
Low Barrier				1.19	0.94–1.51	
Moderate Barrier				0.87	0.59–1.28	
High Barrier				0.91	0.48–1.70	
Weather as a Barrier						< 0.001
Almost Always				0.73	0.53–1.01	
Most of the Time				0.95	0.67–1.34	
Some of the Time				2.01	1.50–2.68	
A little of the Time				2.23	1.59–3.12	
Never				1.00	Reference	
Length of Time in Neighborhood						0.341
< 1 year				0.93	0.58–1.47	
1–3 years				1.01	0.71–1.42	
4–10 years				1.19	0.91–1.55	
11–20 years				0.84	0.63–1.14	
> 20 years				1.00	Reference	

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