Subpopulation differences in the association between neighborhood urban form and neighborhood-based physical activity

Gavin R McCormack[1], Alan Shiell[2], Patricia K Doyle-Baker[3], Christine M. Friedenreich[1,4], Beverly A Sandalack[5].

[1]Department of Community Health Sciences, University of Calgary, Alberta, Canada

[2]The Centre of Excellence in Intervention and Prevention Science (CEIPS), Melbourne, Victoria, Australia

[3]Faculty of Kinesiology, University of Calgary, Alberta, Canada

[4]Department of Population Health Research, Alberta Health Services, Alberta, Canada

[5]Faculty of Environmental Design, University of Calgary, Alberta, Canada

Corresponding author: Dr. Gavin McCormack, Department of Community Health Sciences, University of Calgary, 3280 Hospital Drive, N.W. Calgary, Alberta, T2N 4Z6

Telephone: 1-403-220-8193 Facsimile: 1-403-210-3818 Email: gmccorma@ucalgary.ca

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ABSTRACT

This study investigated whether associations between the neighborhood built environment and neighborhood-based physical activity (PA) varied by sociodemographic and health-related characteristics. A random sample of adults (n=2006) completed telephone- and self-administered questionnaires. Questionnaires captured PA, sociodemographic, and health-related characteristics. Neighborhood-based PA (MET-minutes/week) was compared across low, medium, and high walkable neighborhoods for each sociodemographic (sex, age, dependents, education, income, motor vehicle access, and dog ownership) and health-status (general health and weight status) subpopulation. With few exceptions, subpopulations residing in high walkable neighborhoods undertook more ($p<0.05$) neighborhood-based PA than their counterparts in less walkable neighborhoods. Improving neighborhood walkability is a potentially effective population health intervention for increasing neighborhood-based PA.

Key words: population health; walkability; built environment; neighborhood; physical activity

Highlights

- The associations between walkability and physical activity among subpopulations are unknown.
- For most subpopulations, positive associations between walkability and physical activity exist.
- Improving walkability is part of socio-ecological approach for increasing physical activity.

BACKGROUND

Evidence regarding the importance of the built environment in supporting physical activity has rapidly increased during the past decade. Specifically, there is observational epidemiologic evidence for a relationship between several built environmental attributes, such as pedestrian connectivity, access and proximity to a mix of land uses, residential and population density and physical activity (Wendel-Vos et al., 2007). Few studies however, have investigated whether or not neighborhood built environments supportive of physical activity, benefit most or all subpopulations defined by different demographic characteristics (e.g., sex, age, socioeconomic status, ethnic groups) (Forsyth et al., 2009, Boone-Heinonen and Gordon-Larsen, 2011). Population health interventions are policies and programs that operate within and outside the health sector and have the potential to impact health at a population level (Hawe and Potvin, 2009). These interventions focus on the social determinants of health (i.e., environments, policy, legislation) and attempt to improve health at a population level while at the same time reducing, or at least not exacerbating, inequalities (Kindig and Stoddart, 2003). There is limited evidence regarding the social distribution of physical activity effects resulting from population and community-wide health interventions, including those that focus on creating physical activity supportive built environments (Ogilvie et al., 2007, Humphreys and Ogilvie, 2013).

As a population health intervention, creating physical activity supportive built environments (herein termed “walkability”) appears to be positively associated with physical activity at least when subpopulation differences are not considered (Mozaffarian et al., 2012). It is possible however, that while some groups benefit from the creation of more walkable neighborhoods, the physical activity of other subpopulations may not improve, or could be negatively affected by such interventions (Gordon-Larsen and Popkin, 2011). For example, community-wide interventions, including one in Norway that engaged community sporting clubs and associations in the delivery of health promotion activities (Lupton et al., 2003), and another in Queensland, Australia, that included a pedometer-based intervention (Brown et al., 2006), found different patterns of change in physical activity for men and women. To improve understanding of whether or not the neighborhood built environment can lead to sustainable and even, socially distributed effects on physical activity for populations, more research investigating these built environment-physical activity associations among subpopulations is needed (Gordon-Larsen and Popkin, 2011).

Inequality in the distribution of neighborhood physical activity resources (access to facilities, access to transit, availability of public open space, etc.) might explain subpopulation differences in physical activity. This evidence however, is equivocal, with some studies suggesting better access to physical activity-related resources in less affluent neighborhoods (Macintyre, 2007, Lamb et al., 2012). It is plausible that improving neighborhood "walkability" will not influence the physical activity of all subpopulations to the same extent – discordant with the premise of equality of benefits underlying the population health approach (Gordon-Larsen and Popkin, 2011). Forsyth et al. (2009) examined the association between the built environment and different types of physical activity among subpopulations – i.e., groups based on different sociodemographic and health-related characteristics – and found that residing in a high residential density neighborhood was associated with higher levels of transportation walking regardless of participant's sociodemographic and health characteristics. The researchers noted however, that white and non-obese adults, but not other subgroups, residing in high population density neighborhoods undertook less total physical activity than their counterparts residing high density neighborhoods

(Forsyth et al., 2009). Similarly, stronger associations between the built environment and walking frequency among whites compared with blacks have been found elsewhere (Scott et al., 2009). Other evidence suggests that the availability of neighborhood physical activity resources might increase physical activity levels among socioeconomic disadvantaged groups and women to a greater extent than affluent groups and men, respectively (Pearce and Maddison, 2011). Subgroup analysis can provide important information about the social distribution of health inequalities not attained when data from different social strata are pooled (Petticrew et al., 2012). This study applied subgroup analysis to investigate whether or not neighborhood walkability was associated with neighborhood-based physical activity of adults with different sociodemographic and health-related characteristics.

METHOD

Sample

The methods of the current study have been previously described (McCormack et al., 2012, McCormack et al., 2013). Briefly, two random cross-sectional samples of Calgary adults (≥18 years of age) participated in telephone-interviews between August and October, 2007 (n=2199; response rate=33.7%) and January and April, 2008 (n=2223; response rate=36.7%). The interview captured physical activity-related (behavior and psychosocial factors) and sociodemographic characteristics. After completing the telephone-interview, participants were invited to complete a self-administered questionnaire that captured additional physical activity-related as well as other health and demographic information. Of the questionnaires mailed (n=3602), 2006 completed questionnaires were returned. Participants who completed both the telephone-interview and self-administered questionnaire were included in the current study. The Conjoint Health Research Ethics Board at the University of Calgary granted ethics approval for this study.

Neighborhood walkability

The procedure used to identify neighborhoods with varying levels of walkability for the current study has been described elsewhere (McCormack et al., 2012). Briefly, a cluster analysis model was fitted to objectively-measured environmental data including: walkshed area (a measure of street connectivity), density of businesses and services, density of bus stops, sidewalk length, mix of park types, mix of recreational facilities, population density, pathway and cycleway length, and the proportion of area as green space. Most of these environmental attributes were measured within a 1.6km network radius (the walkshed) of the participant's home (geocoded postal code), with city administrative neighborhood boundary data used when walkshed level data were not available. The used of residential postal codes is less accurate for geocoding households compared with using complete residential addresses; however, this approach still provides a valid measure for the geographical location of Canadian households (Bow et al., 2004). Three neighborhood types were identified from the cluster analysis model: high walkable (HW); medium walkable (MW), and; low walkable (LW). Compared with LW and MW neighborhoods, HW neighbourhoods had significantly ($p<0.05$) higher connectivity, population density, business density, bus stop density, and pathway/cycleway availability. Compared with LW neighborhoods, MW neighborhoods had significantly ($p<0.05$) higher connectivity, business density, bus stop density, and sidewalk availability. The proportion of neighborhood green space and mix of park types was higher in LW versus MW and HW neighborhoods. A detailed statistical description of the differences in the environmental characteristics between the three neighborhood types is presented elsewhere (McCormack et al., 2012).

Sociodemographic and health-related subgroups

The telephone-interview captured sex, age, highest education achieved (high school or less vs. college or university and number of dependents <18 years of age residing at home (none vs. at least one child). The self-administered questionnaire captured motor vehicle access (always vs. sometimes or never), annual household income (<$80000/year vs. ≥$80000/year vs. don't know or refused), dog ownership (not an owner vs. own at least one dog), self-rated health (poor, fair or good vs. very good or excellent), and self-reported height and weight. Self-reported height and weight was used to estimate body mass index (BMI), that was dichotomized into healthy weight (<25 kg/m^2) vs. overweight (≥25 kg/m^2).

Neighborhood-based physical activity

During the telephone-interview, self-reported time spent walking for transportation and recreation, and participating in moderate-intensity and vigorous-intensity physical activity (PA) inside the neighborhood during a usual week was captured. The neighborhood was defined as the area within a 15-minute walk of the participant's home. These items have acceptable levels of reliability (Giles-Corti et al., 2006, McCormack et al., 2009). Minutes of neighborhood-based transportation and recreational walking and moderate-intensity PA were multiplied by 3.0 Metabolic Equivalents (METs) and minutes of vigorous-intensity PA multiplied by 6.0 METs to obtain an estimate of weekly energy expenditure (Ainsworth et al., 2000). Energy expenditure for the four physical activities was summed to provide a measure of total neighborhood-based PA (i.e., MET-minutes/week).

Statistical analysis

Pearson's chi-square tests were used to determine whether or not sociodemographic and self-reported health profiles (i.e., frequencies) differed between the LW, MW, and HW neighborhoods. Bonferroni z-tests were used for pairwise comparisons of proportions between the neighborhood types. Generalized Linear Mixed Models (with gamma distribution and identity link function) were used to estimate marginal means and 95% confidence intervals. The marginal means represented the total MET-minutes of neighborhood-based PA undertaken in a usual week, adjusted for model covariates. Unadjusted (not shown) and adjusted models were tested and the differences in MET-minutes/week of neighborhood-based PA between the three neighborhood types were compared for each sociodemographic (motor vehicle access, age, sex, education, income, and dog ownership) and self-reported health (BMI and self-rated health) subgroup. *A priori* pairwise comparisons were then undertaken to identify statistically significant differences in PA between the: 1) HW and MW, and; 2) HW and LW, neighborhood types. The same regression models were re-estimated using the log-transformed MET-minutes/week as the outcome in order to show the percentage difference in mean neighborhood-based PA levels between the LW and MW neighborhoods compared with the HW neighborhood – a positive value (%) indicated higher neighborhood-based PA in the HW relative to the LW or MW neighborhoods whereas a negative value (%) indicated lower neighborhood-based PA in the HW relative to the LW and MW neighborhoods.

RESULTS

Sample characteristics

There were 1798 participants who provided complete telephone- and self-administered questionnaire data for the analysis. The study participants were mainly women (62%), middle-aged (45% between 41-60 years), well educated (71% with postsecondary education), empty nesters (66% without children living at home), who had a relatively high income (49% with ≥$80000 annual household income), were overweight (53%), in poor to good health (53%), did not own a dog (73%), and had access to a motor vehicle (87%) (Table 1). The simple random sampling design resulted in fewer participants sampled from HW neighborhoods (7%) compared with MW (36%) and LW (57%) neighborhoods.

Sex, education, self-rated health, and weight status profiles were not significantly different ($p > 0.05$) between the three neighborhood types (Table 1). Level of motor vehicle access differed according to neighborhood walkability with the highest proportion of those reporting sometimes or never having access to a motor vehicle residing in HW neighborhoods (31%) (Table 1). MW neighborhoods included a higher proportion of ≥61 year olds (31.5%) and a lower proportion of 18 to 40 year olds (22.4%) compared with the other neighborhood types. LW neighborhoods included a higher proportion of participants with a child at home (39.6%) than the more walkable neighborhoods. Compared with HW and MW neighborhoods, a higher proportion of participants in the LW neighborhood reported an annual household income of $80000 or more (54.2%). The proportion of dog owners in HW neighborhoods was lower (18.3%) compared with the proportion of dog owners in LW neighborhoods (28.5%).

Neighborhood differences in neighborhood-based physical activity energy expenditure

For all subgroups, except for participants' ≥60 years of age, overweight, or owning dogs, neighborhood-based PA was significantly ($p<0.05$) higher in HW neighbourhoods (range across subgroups: 909-1245 MET-minutes/week) versus MW (range across subgroups: 566-826 MET-minutes/week) or LW (range across subgroups: 566-933 MET-minutes/week) neighborhoods (Table 2).

Percentage difference in neighborhood-based physical activity between neighborhoods

The largest percentage difference in neighborhood-based PA (MET-minutes/week) was between participants reporting "sometimes or never" having access to a motor vehicle who resided in a HW versus LW neighborhood (72% higher in the HW neighborhoods, $p<0.05$) (Figure 1A). The lowest percentage difference in neighborhood-based PA was found between those overweight and residing HW versus those overweight and residing in MW neighborhoods (32.8% higher in HW neighborhoods, $p<0.05$) (Figure 1B). For five sociodemographic characteristics (motor vehicle access sometimes or never, ≥61 years of age, high school or less education, earning ≥$80000/year, not owning a dog) weekly neighborhood-based PA was at least 50% higher among those residing in HW versus MW neighborhoods (Figure 1B). For six sociodemographic and health-related characteristics (motor vehicle access sometimes or never, ≥1 child at home, males, ≥$80000/year, not owning a dog, and not being overweight) neighborhood-based PA was at least 50% higher among those residing in HW versus LW neighborhoods (Figure 1A).

DISCUSSION

In support of previous research, the findings of this study suggest that adults residing in high walkable neighborhoods may undertake more neighborhood-based PA compared with those residing in less walkable neighborhoods. A unique contribution to this evidence however, is our finding that this relationship between walkability and PA appears to exist regardless of the participants' sociodemographic and self-rated health characteristics. In other words, adults from most of the sociodemographic and health-related sub-groups examined in our study might benefit from residing in neighborhoods that are highly walkable in terms of achieving higher levels of PA. A noteworthy exception however, was our finding that neighborhood walkability may not be associated with neighborhood-based PA levels to the same extent for overweight versus healthy weight adults.

Overweight adults might accrue greater health benefits from participating in physical activity compared with healthy weight adults. Neighborhood-based PA levels however, were not significantly different between the three neighborhood types (low, medium, and high walkability) for overweight adults despite neighborhood differences being found for healthy weight adults. It should be noted that when neighborhood-based PA was log-transformed, we found, on average, a 33% higher level of PA among overweight adults residing in HW versus LW neighborhoods. Given that the determinants of overweight and obesity are multi-faceted (Wang and Beydoun, 2007) and habits that lead to weight gain are difficult to modify (Fogelholm and Kukkonen-Harjula, 2000, Elfhag and Rössner, 2005), this finding is not unexpected. Improving a neighborhood's supportiveness for PA could be one of several multilevel strategies needed to encourage higher levels of PA among overweight and obese adults.

Our results suggest that owning a dog in an urban environment might be protective against the potential PA lowering effect of residing in a less walkable neighborhood. Neighborhood-based PA among dog owners did not significantly differ between the three neighborhood types, although differences in PA were found among those not owning a dog. On average, dog-owners might be more physically active regardless of the type of neighborhood that they live in because their pet dogs require exercise for their own health. Using longitudinal data, we found that owning a pet dog might also protect against seasonal fluctuations in neighborhood-based walking from winter to summer (Lail et al., 2011) suggesting that owning a dog might counteract the effect of some environmental barriers on PA (e.g., inclement weather or low walkability). Other evidence suggests that the neighborhood built environment is associated with the amount owners walk their dogs (McCormack et al., 2011, Coleman et al., 2008) but our results suggest that dog-owner's neighborhood-based PA levels do not significantly differ by level of neighborhood walkability. Regardless, dog ownership should not be promoted as a resource to compensate for low levels of PA that might result from residing in a LW neighborhood. The findings presented here are cross-sectional, and it is possible that those who adopt or purchase pet dogs do so to support their current preference to participate in PA. Moreover, owners may take into account their own and their dog's health and lifestyle needs when choosing a neighborhood.

Our results are encouraging given that an assumption of population health interventions is that the benefits of the intervention should be reasonably equally distributed across the population of interest. Higher levels of neighborhood-based PA were found among low and high income and education subgroups residing in high walkable neighborhoods. Moreover, our results seem to suggest that compared with those who are highly educated, those least educated might gain from residing in a HW neighborhood with regard to their PA levels. For example, the mean percent difference in neighborhood-based PA among those with high school or less education residing in MW versus HW neighborhood was 53%. In comparison, for those with a tertiary level of education residing in MW versus HW neighborhoods the difference in mean neighborhood-based PA was about 35%. This finding supports previous evidence that the availability of local PA resources are reported to have a greater influence on the socioeconomically disadvantaged compared with more affluent individuals (Pearce and Maddison, 2011). In general, lower socioeconomic status is associated with lower PA levels (Stalsberg and Pedersen, 2010, Beenackers et al., 2012) and ill health (Braveman et al., 2010). Creating walkable environments, especially in neighborhoods with high concentrations of socioeconomic disadvantaged households, could provide opportunities for PA and in turn help improve health and wellbeing of local residents.

We found that those who report "sometimes or never" having access to a motor vehicle have the most to gain, in terms of PA, from residing in a HW neighborhood. Our results suggest that mean neighborhood-based PA energy expenditure was 72% higher in HW versus LW neighborhoods among those reporting access to a motor vehicle only sometimes or never. Other studies have found that not owning a motor vehicle or having irregular access to a motor vehicle is associated with higher levels of moderate-to-vigorous intensity PA and walking for transportation (Besser and Dannenberg, 2005, Eriksson et al., 2012). Eriksson et al. (2012) found that motor vehicle ownership was a mediator, but not a moderator, of the association between walkability indicators and moderate-to-vigorous intensity PA and walking for transportation. From our results it appears that, irregular access to a motor vehicle does not significantly contribute to neighborhood-based PA levels when residing in a LW or MW neighborhood. This result might reflect less accessibility to local destinations within walking distance in less walkable neighborhoods. Evidence suggests that neighborhood-based recreational walking undertaken between neighborhoods of differing levels of walkability are often similar, while levels of transportation walking increases with higher levels of neighborhood walkability (Saelens and Handy, 2008). Physical activity campaigns encouraging people to replace local private motor vehicle trips with active transportation trips may not achieve their desired outcome if the neighborhoods in which people live do not adequately support active transportation (e.g., high pedestrian connectivity and a mix of easily accessible local destinations).

This study's findings should be considered in light of its cross-sectional design, modest response rate, reliance on self-reported measures of PA and health-related data, and omission of potentially important, but unavailable, sociodemographic (e.g., ethnicity and occupation) and health-related characteristics (e.g., disabilities). The original sample (all telephone-interview participants) included a higher proportion of women, Canadian born, home owners, younger adults, and children <18 years at home, and higher education levels compared to the target population (McCormack et al., 2010). Furthermore, the simple random sample design contributed to a lower proportion of study participants being recruited from high walkable neighborhoods. Most high walkable neighborhoods are located within the city's urban center (Sandalack et al., 2013) and compared with suburban neighborhoods often have smaller residential populations. This limitation also meant that we were unable to create separate overweight and obese groups because of the small number of obese study participants residing in the HW neighborhoods. The lower sample size in the high walkable neighborhood group might have negatively impacted the statistical power in the subgroup analysis to detect neighborhood differences in PA. The influence of neighborhood self-selection on the estimated associations between the built environment and physical activity in this study cannot be ruled out. Nevertheless, statistical adjustment for neighborhood preferences or reasons for residing in neighborhoods associated with physical activity has been found to have only a small attenuating effect on estimated associations between the built environment and physical activity (McCormack and Shiell, 2012). Moreover, while our study did not capture occupational and household physical activity, participation in these and other domains of physical activity could influence how much physical activity adults undertake inside their neighborhood. Finally, it is possible that our self-report measure of PA, and the combining of multiple physical activities undertaken inside the neighborhood into a single variable, could have led to an overestimate of actual PA levels. Self-report measures are known to provide inaccurate and biased estimates of PA (Klesges et al., 1990, Adams et al., 2005). These inaccuracies might be more severe for some subgroups versus others; for example, groups with lower education or with poorer health. In comparison, PA monitors (i.e., accelerometers) combined with global positioning devices might provide more accurate and reliable estimates of the PA undertake inside versus outside the neighborhood (Troped et al., 2010).

This study contributes important findings to the dearth of evidence on the subpopulation PA effects of population-level interventions (Ogilvie et al., 2007, Humphreys and Ogilvie, 2013, Baker et al., 2011). While our findings indicate that more “walkability” is positively associated with PA levels among most subpopulations, our study does not address the issues related to the distribution, affordability, and exposure to walkable neighborhoods that may differ between subpopulations (Talen, 2013b). Some evidence suggests that the limited supply of and high demand for pedestrian-friendly neighborhoods, has contributed to higher land and house values in these neighborhoods (Washington, 2013). Despite the positive influence of walkability on PA of adults across socioeconomic levels, these benefits may not be realized among less affluent adults who cannot afford to own or rent homes in high walkable neighborhoods. Thus creating walkable neighborhoods alone may not be sufficient to increase population-levels of PA unless other interventions are in place that make these neighborhoods available, affordable, and appealing to all subpopulations (Talen, 2013a). Moreover, our study takes a narrow focus of neighborhood influences on PA. We deliberately focused on built characteristics that are commonly associated with promoting walkability. We acknowledge however, that these same neighborhoods may be less supportive of health or less livable in other ways (e.g., high crime and incivilities) (Talen, 2013b, Neckerman et al., 2009). Our study findings suggest that creating walkable neighborhoods has the potential to promote and support neighborhood-based PA for different sociodemographic and health-related subgroups. Improving the walkability within existing neighborhoods may be a potentially effective population health intervention for encouraging PA but more research is needed.

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Table 1. Sample characteristics overall and by neighborhood type (high, medium, and low walkability)

Characteristics		Overall		High walkable		Medium walkable		Low walkable	
		N	(%)	N	(%)	N	(%)	N	(%)
Motor vehicle access	**Always[a,b]**	1560	(86.8)	87	(69.0)	562	(86.7)	911	(89.0)
	Sometimes or never[a,b]	238	(13.2)	39	(31.0)	86	(13.3)	113	(11.0)
Age	**18 to 40 yrs[c]**	504	(28.0)	40	(31.7)	145	(22.4)	319	(31.2)
	41 to 60 yrs	815	(45.3)	62	(49.2)	299	(46.1)	454	(44.3)
	≥61 yrs[a, c]	479	(26.6)	24	(19.0)	204	(31.5)	251	(24.5)
Children <18 yrs at home	**None[b,c]**	1180	(65.6)	102	(81.0)	460	(71.0)	618	(60.4)
	≥ 1 child[b,c]	618	(34.4)	24	(19.0)	188	(29.0)	406	(39.6)
Sex	**Men**	686	(38.2)	55	(43.7)	256	(39.5)	375	(36.6)
	Women	1112	(61.8)	71	(56.3)	392	(60.5)	649	(63.4)
Highest education	**High school or less**	524	(29.1)	37	(29.4)	208	(32.1)	279	(27.2)
	College/University	1274	(70.9)	89	(70.6)	440	(67.9)	745	(72.8)
Annual household income*	**<$80000 per year [b,c]**	762	(42.4)	69	(54.8)	324	(50.0)	369	(36.0)
	≥$80000 per year [b,c]	876	(48.7)	49	(38.9)	272	(42.0)	555	(54.2)
	Don't know/refused	160	(8.9)	8	(6.3)	52	(8.0)	100	(9.8)
Self-reported health	**Poor to good**	993	(55.2)	81	(64.3)	360	(55.6)	552	(53.9)
	very good/excellent	805	(44.8)	45	(35.7)	288	(44.4)	472	(46.1)
Weight status	**Not overweight**	853	(47.4)	68	(54.0)	304	(46.9)	481	(47.0)
	Overweight	945	(52.6)	58	(46.0)	344	(53.1)	543	(53.0)
Dog ownership	**None[b]**	1316	(73.2)	103	(81.7)	481	(74.2)	732	(71.5)
	≥ 1 dog[b]	482	(26.8)	23	(18.3)	167	(25.8)	292	(28.5)

[a] HW significantly different to MW (p<.05; based on Bonferroni adjusted pairwise z-test for proportions)
[b] HW significantly different to LW (p<.05; based on Bonferroni adjusted pairwise z-test for proportions)
[c] MW significantly different to LW (p<.05; based on Bonferroni adjusted pairwise z-test for proportions)

Table 2. Neighborhood-based physical activity (marginal mean MET-minutes per usual week) by neighborhood walkability and stratified by participant characteristics (multivariate estimates)[3]

Characteristics		High walkable		Medium walkable		Low walkable	
		Mean	95% CI	Mean	95% CI	Mean	95% CI
Motor vehicle access	**Always**[1,2]	909.45	742.21, 1076.69	679.81	611.65, 747.97	683.07	621.40, 744.74
	Sometimes or never[1,2]	1245.15	895.30, 1595.00	720.11	322.36, 1117.86	729.67	250.06, 1209.28
Age	**18 to 40 yrs**[1,2]	1056.07	838.13, 1274.02	711.58	592.95, 830.21	694.85	587.41, 802.30
	41 to 60 yrs[2]	954.74	714.73, 1194.76	724.82	604.84, 844.80	663.31	530.24, 796.38
	≥61 yrs	940.92	592.91, 1288.93	660.07	472.58, 847.56	729.79	556.06, 903.51
Children <18 yrs at home	**None**[1,2]	1051.21	893.84, 1208.58	774.02	678.43, 869.60	788.42	690.92, 885.92
	≥ 1 child[2]	1094.36	680.20, 1508.51	691.65	538.48, 844.82	617.90	494.31, 741.50
Sex	**Men**[1,2]	1016.26	789.46, 1243.07	705.46	580.85, 830.08	673.91	553.32, 794.51
	Women[1,2]	1058.49	851.02, 1265.96	725.54	631.58, 819.49	757.19	671.02, 843.35
Highest education	**High school or less**[1,2]	1071.86	798.24, 1345.47	743.51	591.15, 895.88	778.27	630.63, 925.91
	College/University[1,2]	1003.35	823.70, 1182.99	736.35	651.50, 821.20	703.35	619.82, 786.89
Annual household income	**<$80000 per year**[1,2]	1124.93	914.43, 1335.44	791.48	679.49, 903.47	807.37	690.86, 923.87
	≥$80000 per year[1,2]	1084.84	836.23, 1333.46	677.90	560.58, 795.22	674.56	575.84, 773.29
Self-reported health	**Poor to good**[1,2]	948.65	763.24, 1134.05	646.37	549.03, 743.71	671.37	577.74, 765.01
	very good/excellent[1,2]	1100.70	839.69, 1361.71	826.17	706.64, 945.70	766.67	653.80, 879.53
Weight status	**Not overweight**[1,2]	1129.70	916.65, 1342.75	753.82	653.34, 854.30	678.20	581.13, 775.27
	Overweight	926.65	719.98, 1133.31	723.34	603.29, 843.40	773.32	662.35, 884.29
Dog ownership	**None**[1,2]	919.54	760.26, 1078.83	566.64	492.90, 640.38	565.55	493.50, 637.60
	≥ 1 dog	872.31	484.93, 1259.69	935.47	754.30, 1116.64	932.60	757.85, 1107.36

Planned pairwise comparisons between the low and median walkable neighborhoods versus the high walkable neighborhood for each category undertaken when overall test of mean difference was significant (p<0.05)

[1] "High walkable neighborhood" significantly different (p<0.05) to "medium walkable neighborhood"

[2] "High walkable neighborhood" significantly different (p<0.05) to "low walkable neighborhood"

[3] Marginal means (MM) and 95% CI adjusted for motor vehicle access, age, children <18 years at home, sex, education, household income, self-report health, weight status, and dog ownership.

*Don't know/refused annual household income category not shown in the table

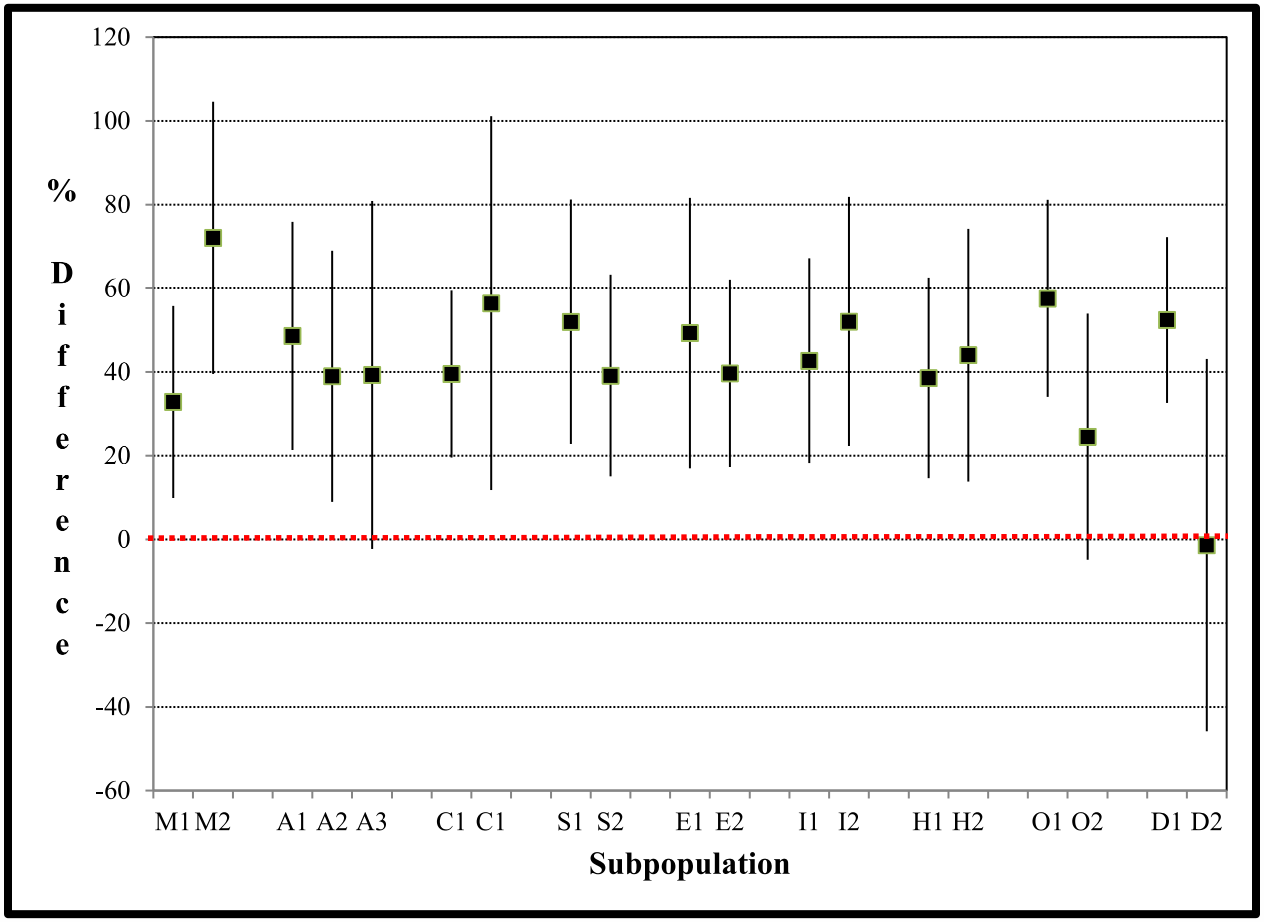

Figure 1A: Percent difference in mean total neighborhood-based physical activity (MET-minutes/week) between LW (ref.) vs. HW neighborhoods. for each subpopulation (M1: motor vehicle access always; M2: motor vehicle access never/sometimes; A1: 18-40 yrs; A2: 41-60 yrs; A3: ≥61 yrs of age; C1: No children at home; C2: ≥1children at home; S1:men; S2: women; E1: high school or less; E2: college or university; I1: <$80000/yr; I2: ≥$80000/yr; H1: Poor to good health; H2: very good to excellent health; O1: not overweight; O2: overweight; D1: not dog owner; D2: dog owner. Whiskers represent 95% confidence intervals.

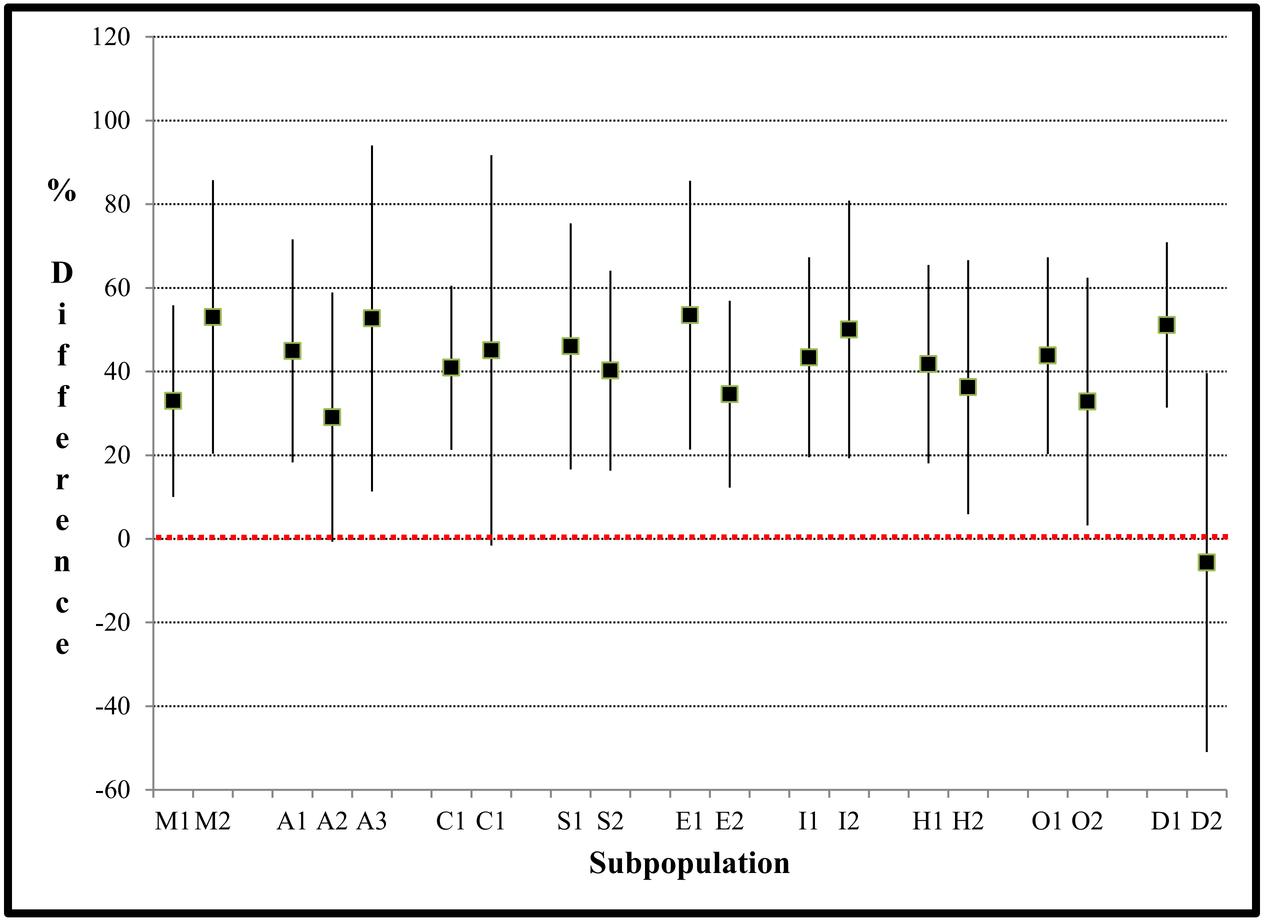

Figure 1B: Percent difference in mean total neighborhood-based physical activity (MET-minutes/week) between MW (ref.) vs. HW neighborhoods. for each subpopulation (M1: motor vehicle access always; M2: motor vehicle access never/sometimes; A1: 18-40 yrs; A2: 41-60 yrs; A3: ≥61 yrs of age; C1: No children at home; C2: ≥1children at home; S1:men; S2: women; E1: high school or less; E2: college or university; I1: <$80000/yr; I2: ≥$80000/yr; H1: Poor to good health; H2: very good to excellent health; O1: not overweight; O2: overweight; D1: not dog owner; D2: dog owner. Whiskers represent 95% confidence intervals.