Urban design, socioeconomic status, seasonality and neighborhood walking: Findings from the EcoEUFORIA project

McCormack GR,[1] Shiell A,[1] Sandalack BA,[2] Doyle-Baker PK,[3] Giles-Corti B,[4] Friedenreich C,[5] Alaniz Uribe F.[2]

Faculties of Medicine[1,] Environmental Design[2], and Kinesiology[3], University of Calgary, School of Population Health, University of Western Australia[4], Alberta Health Services – Cancer Care, Calgary, Canada[5]

Background

There is increased focus on the role of environments in determining physical activity behavior.

Natural (weather, seasonality) as well as man-made attributes such as residential density, land use mix, traffic and personal safety, street/sidewalk connectivity, and aesthetics are important factors for walking.[1] The neighborhood social context including socio-economic status (SES) is also important.[2]

Evidence for the association between environments and physical activity rarely control for individual's choices to reside in neighborhoods that support their lifestyle preferences. It is also not known whether seasonal influences on physical activity attenuates for those residing in more walkable neighborhoods.

Objective: To examine whether or not season, neighborhood SES, and neighborhood characteristics (i.e., walkability and crime) are associated with neighborhood walking for transportation (**NWT**) and recreation (**NWR**) while adjusting for reasons for residential selection, attitudes toward walking, and demographic characteristics.

Method

Setting and Sample
Calgary is located east of the Rocky Mountains, at an elevation over one kilometer above sea level, with a continental climate. Two independent random cross-sectional samples of adults (≥18 years) recruited during telephone-interviews between August-October, 2007 (n=2199; response rate=33.6%) and January-April, 2008 (n=2223; response rate=36.7%).[3]

Measures
Season: Spring, winter, fall, or summer based on the date of the telephone-interview.

Neighborhood walkability: Respondents' home postal codes were geocoded and their walksheds estimated using a 1.6km line-based street/pedestrian network buffer (Figures 1-3).[4] For each walkshed, the number of businesses, public recreational facilities, schools were determined. Neighborhood population density was derived from Census data. Walkshed area, number of businesses, public recreation facilities, schools, and population density were standardized (*z*) and summed to form a walkability index representing connectivity, land use diversity, and density (α=0.82).

Neighborhood crime index: Number of street robberies, assaults, and mischievous events in the previous 12 months.

Neighborhood SES: ***Social deprivation*** – estimated as the sum of the proportions of individuals living alone, renting, and separated/divorced/widowed); and ***income deprivation*** – estimated as the sum of the proportions without high school diplomas, single parent families, median household income as estimated from Census data (α=0.83 and 0.70, respectively).[5]

Residential selection: Items capturing respondents' reasons for moving to the neighborhood formed four self-selection scales: physical activity opportunities (α=0.79); access to transit and services (α=0.53); sense of community (α=0.71); and ease of driving (α=0.54). Ease of walking was examined separately.

Walking attitudes: Instrumental (foolish, beneficial, useful) and affective (enjoyable, relaxing, interesting) attitudes toward walking were captured (α=0.73 and 0.81, respectively).

Demographics: Sex, age, education, home ownership, and number dependents <18 years.

Neighborhood-specific walking: NWT and NWR (within a 15 minute walk of home) in usual week[6,7] were each recoded into insufficient (<150min/wk) versus sufficient (≥150min/wk).

Analysis
Using demographic-adjusted multivariate logistic regression models, sufficient NWT/NWR were sequentially regressed onto: 1) season; 2) social and income deprivation (reversed scored); 3) walkability and crime, and; 4) attitudes and neighborhood selection.

Results

Of the 4266 respondents with complete data (women=59.7%; age<45yrs=45.8%; home owners=80.5%; ≤high school=32.5%; no dependents=63.2%), 15.1% participated in sufficient NWT and 34.4% participated in sufficient NWR.

The likelihood of sufficient NWT significantly (p<.05) decreased with improved neighborhood social deprivation and increased with higher neighborhood walkability even after adjusting for attitude and residential selection. NWT was associated with season, although this became non-significant after adjustment for all other factors. The fully adjusted model explained 23% of the variance in the likelihood of sufficient NWT (Table 1).

The likelihood of sufficient NWR significantly increased with less neighborhood income deprivation, although the association became non-significant after adjusting for attitude and residential selection. Sufficient NWR was also less likely in winter compared with summer in all models. The fully adjusted model explained 15.2% of the variance in the likelihood of sufficient NWR (Table 1).

Table 1. Odds ratios (OR) for the associations between season, SES, walkability and crime, walking attitudes, and residential selection and walking ≥150mins/wk (n=4266)

	Neighborhood walking for transportation				Neighborhood walking for recreation			
	OR[1]	OR[2]	OR[3]	OR[4]	OR[1]	OR[2]	OR[3]	OR[4]
Season								
Summer	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fall	0.70†	0.73†	0.74†	0.76	0.92	0.91	0.91	0.88
Winter	0.63†	0.66†	0.80	0.78	0.72†	0.70†	0.70†	0.68†
Spring	0.68†	0.72†	0.88	0.82	0.97	0.95	0.95	0.87
Neighborhood SES								
Social deprivation index		0.84†	0.90†	0.94†		1.01	1.01	1.03
Income deprivation index		1.02	1.02	0.98		1.06†	1.06†	1.01
Neighborhood environment								
Walkability index			1.08†	1.06†			0.99	0.99
Person crime index			1.00	1.00			1.00	1.00
Walking attitudes								
Instrumental attitude				1.37†				1.40†
Affective attitude				1.29†				1.66†
Residential selection								
Physical activity opportunity				1.80†				2.04†
Proximity to services				1.67†				0.78†
Sense of community				0.78†				0.79†
Ease of driving				0.49†				0.90
Ease of walking				1.78†				1.34†
*% explained variance**	*7.0*	*11.0*	*13.0*	*23.0*	*3.7*	*4.4*	*4.4*	*15.2*

[1]Season only; [2]Season, and SES; [3]Season, SES, walkability, and crime; [4]Season, SES, walkability, crime, attitude, and residential selection. All estimates adjusted for sex, age, education, home ownership, and number of dependents <18 years of age. *Nagelkerke R^2; †p<.05

Conclusion

Season, neighborhood SES, and walkability contribute to neighborhood walking even after individual-level characteristics, including attitudes and residential selection, are taken into account. Our finding also suggests that the association between season and NWT to some extent may be influenced by the neighborhood environment, neighborhood SES, and individual-level characteristics.

Developing new, and retrofitting established, neighborhoods to improve connectivity, land use mix and accessibility, and population density has the potential to increase neighborhood walking

Future research examining the causal associations between neighborhood environment characteristics and walking independent of residential selection is needed for creating efficacious land use practices and policies.

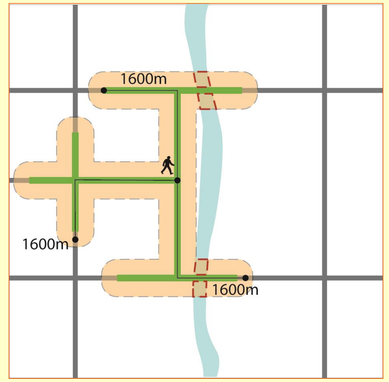

Figure 1: Line-based network buffer estimation

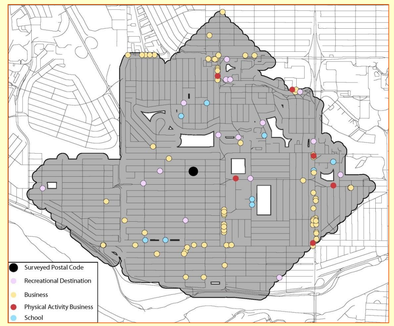

Figure 2: 1.6km line-based network buffer showing a larger walkshed area

Figure 3: 1.6km line-based network buffer showing a smaller walkshed area

References

1. Humpel et al. (2002). Environmental factors associated with adults' participation in physical activity: A review. *Am J Prev Med*.
2. Ross. (2000). Walking, exercising, and smoking: does neighborhood matter? *Soc Sci Med*.
3. McCormack et al. (2010). Gender and age-specific seasonal variations in physical activity among adults. *J Epidemiol Community Health*.
4. Oliver et al. (2007). Comparing circular and network buffers to examine the influence of land use on walking for leisure and errands. Int J Health Geogr.
5. Pampalon & Raymond. (2000). A deprivation index for health and welfare planning in Quebec. *Chronic Dis Can*.
6. McCormack et al. (2009). Testing the reliability of neighborhood-specific measures of physical activity among Canadian adults. *J Phys Act Health*.
7. Giles-Corti et al (2006). Development of a reliable measure of walking within and outside the local neighborhood: RESIDE's Neighborhood Physical Activity Questionnaire. *Prev Med*.

Acknowledgement

The EcoEUFORIA (Economic Evaluation of Urban Form to Increase Activity) project was funded by CIHR. GRM is supported by a CIHR Postdoctoral Fellowship. AS is supported by CIHR/ PHAC Applied Chair and an AHFMR Health Scientist Award. CF is supported by an AHFMR Health Senior Scholar Award.