The Associations Between Urban Form And Walking behavior Among Adults: A neighborhood Perspective

Gavin R. McCormack*[Ψ] and Elizabeth Jack*

*Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Canada
[Ψ]Faculty of Environmental Design, University of Calgary, Canada

Background

- Regular physical activity can reduce the risk of cardiovascular disease, hypertension, type II diabetes, hyperlipidemia, osteoporosis, depression, some cancers, and obesity.[1]

- Perceived and objectively-assessed neighborhood walkability is positively associated with physical activity.[2]

- Perceived and objectively-assessed measures of the same environmental attributes often have only weak-to-moderate agreement.[3,4]

- Perceived and objectively-assessed built environmental characteristics need to be considered in studies investigating relationships between walkability and physical activity.

Study Aim(s)

1) Estimate the relative associations between perceived and objectively-assessed neighborhood urban form and walking.

2) Examine the extent to which perceived neighborhood environment characteristics moderate associations between urban form and walking.

Method

Sample and Study Design

- A random cross-sectional sample of n=1875 urban-dwelling adults residing in Calgary (Canada) completed telephone-interviews and postal surveys.

- Telephone-interviews and postal surveys captured walking, walking-related attitudes, neighborhood preferences, perceived neighborhood walkability, and socio-demographic characteristics.

Survey Variables

- **Neighborhood-based walking:** Self-reported weekly minutes of transportation and recreational walking undertaken inside the neighborhood (≤15-minute walk from home) in the last 7-days.

- **Perceived neighborhood walkability:** Safety from crime, aesthetics, access to services, street connectivity, pedestrian infrastructure, motor vehicle traffic safety, physical barriers, mix of utilitarian destinations, and mix of recreational destinations inside the neighborhood captured using the Abbreviated Neighborhood Environment Walkability Scale.[5]

- **Covariates:** sex, age, education, home ownership, number of children <18 years of age, time residing in neighborhood, neighborhood preferences, and walking-related attitude.

Objectively-Assessed Walkability

- GIS-derived built environment attributes, measured within each participant's 1.6 km line-based network walkshed, underwent a two-staged cluster analysis which identified three neighborhood types[6]: **low walkable (LW); medium walkable (MW); high walkable (HW)**

Environmental Attributes By neighborhood Type

	Low walkability	Medium walkability	High walkability
Walkshed area (km²)	Lowest	Moderate	Highest
# of businesses/km²	Lowest	Moderate	Highest
#of bus stops/km²	Lowest	Moderate	Highest
Mix of park types/km²	Highest	Lowest	Moderate
Mix of recreation destinations/km²	Lowest	Highest	Moderate
Sidewalk m/km²	Lowest	Highest	Moderate
Total population/km²	Lowest	Moderate	Highest
% of green space area	Highest	Moderate	Lowest
Pathway m/km²	Moderate	Lowest	Highest

Findings

Perceived Walkability by Neighborhood Type
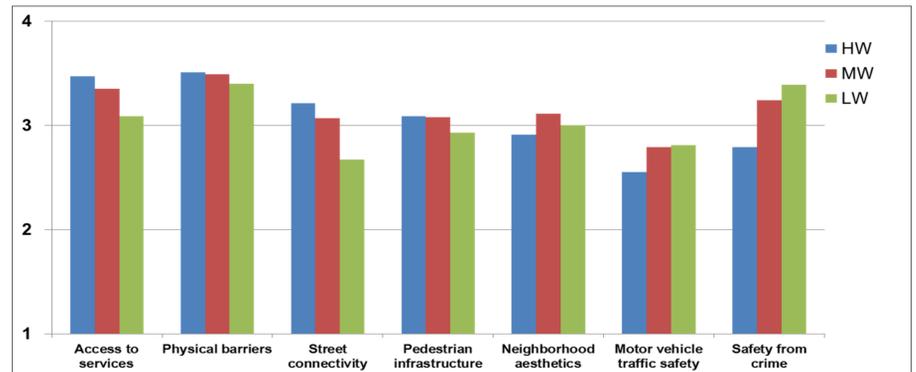
Neighborhood Type, Perceived Walkability, and Transportation Walking

	Participation in transportation walking inside neighborhood (n=1875)	Minutes of transportation walking inside neighborhood among those walking ≥1 times/week (n=754)
	Logistic OR (95%CI)	GLZM β (95%CI)*
Objectively-assessed neighborhood type		
Low walkable (LW)	1.00	119.8 (101.8, 137.8)[c]
Medium walkable (MW)	1.04 (0.82, 1.32)	115.8 (98.6, 132.9)[b]
High walkable (HW)	1.50 (0.94, 2.41)	167.4 (131.6, 203.2)[b,c]
Perceived walkability		
Access to services	1.17 (1.05, 1.32)[†]	-1.01 (-7.03, 5.01)
Physical barriers	0.93 (0.84, 1.04)	-5.03 (-14.42, 4.37)
Street connectivity	1.16 (1.03, 1.30)[†]	-1.28 (-8.22, 5.66)
Pedestrian infrastructure	1.10 (0.99, 1.23)	-2.37 (-11.49, 6.75)
Neighborhood aesthetics	1.01 (0.90, 1.13)	5.07 (-1.19, 11.33)
Motor vehicle traffic safety	1.00 (0.90, 1.12)	7.71 (1.61, 13.82)[†]
Safety from crime	0.95 (0.84, 1.07)	-8.15 (-19.07, 2.77)
Utilitarian destination mix	1.25 (1.08, 1.44)[†]	6.44 (-1.37, 14.26)
Recreational destination mix	1.15 (1.00, 1.32)	-9.31 (-17.24, -1.38)[†]

† = p<.05; [a] = LW significantly differs from MW; [b] = MW significantly differs from HW; [c] = LW significantly differs from HW.
Estimates adjusted for age, gender, education, home ownership, dependents, years lived in neighborhood, attitude towards walking, neighborhood preferences, objectively-assessed neighborhood type, and perceived walkability. OR=Odds ratios; CI=Confidence interval; GZLM=Generalized Linear Model (gamma distribution and identity link function) * = estimated marginal means are reported for objective *neighborhood type*; regression coefficient (β) is reported for all other factors.

Neighborhood Type, Perceived Walkability, and Recreational Walking

	Participation in recreational walking inside neighborhood (n=1875)	Minutes of recreational walking inside neighborhood among those walking ≥1 times/week (n=1065)
	Logistic OR (95%CI)	GLZM β (95%CI)*
Objectively-assessed neighborhood type		
Low walkable (LW)	1.00	161.7 (145.1, 178.3)
Medium walkable (MW)	0.90 (0.71, 1.13)	157.3 (139.5, 175.1)
High walkable (HW)	0.82 (0.54, 1.26)	153.0 (118.2, 187.9)
Perceived walkability		
Access to services	0.99 (0.89, 1.10)	-9.13 (-17.90, -0.36)[†]
Physical barriers	1.03 (0.93, 1.14)	6.45 (-2.03, 14.93)
Street connectivity	1.00 (0.90, 1.12)	0.39 (-8.42, 9.19)
Pedestrian infrastructure	0.94 (0.85, 1.04)	-2.34 (-10.54, 5.86)
Neighborhood aesthetics	1.18 (1.06, 1.32)[†]	2.57 (-6.09, 11.24)
Motor vehicle traffic safety	0.96 (0.86, 1.07)	-5.32 (-14.28, 3.65)
Safety from crime	0.96 (0.86, 1.08)	2.59 (-6.06, 11.24)
Recreational destination mix	1.09 (0.95, 1.24)	4.77 (-3.02, 12.56)

† = p<.05; [a] = LW significantly differs from MW; [b] = MW significantly differs from HW; [c] = LW significantly differs from HW.
Estimates adjusted for age, gender, education, home ownership, dependents, years lived in neighborhood, attitude towards walking, neighborhood preferences, objectively-assessed neighborhood type, and perceived walkability. OR=Odds ratios; CI=Confidence interval; GZLM=Generalized Linear Model (gamma distribution and identity link function) * = estimated marginal means are reported for objective *neighborhood type*; regression coefficient (β) is reported for all other factors.

- **Neighborhood type and perceived walkability interactions**: HW x utilitarian destination mix was positively associated with participation, HW x physical barriers and MW x pedestrian infrastructure were positively associated with transportation walking minutes, and HW x safety from crime was negatively associated with transportation walking minutes.

Conclusions

- Participants residing in high walkable neighborhoods perceive their neighborhoods to be more walkable.

- Both urban form and perceived walkability are important for supporting local walking behavior.

- Interventions targeting perceptions of walkability might be useful for increasing walking when modification to the neighborhood urban form is not feasible.

References

1. Warburton D, et al. Health benefits of physical activity: the evidence. CMAJ 2006,
2. McCormack G, et al. An update of recent evidence of the relationship between objective and self-report measures of the physical environment and physical activity behaviours. J Sci Med Sport 2004.
3. Gebel K, et al. Correlates of non-concordance between perceived and objective measures of walkability. Ann Behav Med 2009.
4. Ball K, et al. Mismatch between perceived and objective measures of physical activity environments. Prev Med2008,
5. Leslie E, et al. Residents' perceptions of walkability attributes in objectively different neighbourhoods: a pilot study. Health Place 2005,
6. McCormack G, et al. The relationship between cluster-analysis derived walkability and local recreational and transportation walking among Canadian adults. Health Place 2012,