Check the score: Field validation of Street Smart Walk Score in Alberta, Canada

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ABSTRACT

Walk Score® is a proprietary walkability metric that ranks locations by proximity to destinations, with emerging health promotion applications for increasing walking as physical activity. Currently, field validations of Walk Score® have only occurred in metropolitan regions of the United States; moreover, many studies employ an earlier Walk Score® version utilizing straight line distance. To address this gap, we conducted a field validation of the newest, network-based metric for three municipal types along a rural-urban continuum in Alberta, Canada. In 2015, using street-level systematic observations collected in Bonnyville, Medicine Hat, and North Central Edmonton in 2008 (part of the Community Health and the Built Environment (CHBE) project), we reverse engineered 2181 scores with the network Walk Score® algorithm. We computed means, 95% confidence intervals, and t-tests ($\alpha = 0.05$) for both sets of scores. Applying the Clifford-Richardson adjustment for spatial autocorrelation, we calculated Spearman's Rank Correlation Coefficients (rho, r_s) and adjusted p-values to measure the strength of association between the derived scores and original network scores provided by Walk Score®. Spearman's rho for scores were very high for Bonnyville ($r_s = 0.950$, adjusted $p < 0.001$), and high for Medicine Hat ($r_s = 0.790$, adjusted $p < 0.001$) and North Central Edmonton ($r_s = 0.763$, adjusted $p < 0.001$). High to very high correlations between derived scores and Walk Scores® field validated this metric across small, medium, and large population centres in Alberta, Canada. However, we suggest caution in interpreting Walk Score® for planning and evaluating health promotion interventions, since the strength of association between destinations and walking may vary across different municipal types.

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1. Introduction

1.1. Walkability and walking for health

Population levels of overweight and obesity are accelerating across the United States and Canada (World Health Organization, 2009). Walking as physical activity is generally feasible for most people, and efforts to increase community walking can help combat this trend, potentially reducing the burden of chronic illnesses (cardiovascular, cerebrovascular, and respiratory diseases; diabetes; and many kinds of cancer) (Guh et al., 2009). Understanding the influence of built environments is key for efforts to increase walking, since most walking occurs routinely in neighborhoods. The term built environment refers to both aggregate and individual features of urban design, transportation infrastructure,

and land uses (Rao et al., 2007). Walkability, a concept from the planning literature evaluating built environments as suitable for walking (Lo, 2009), is a rapidly evolving topic in health promotion research.

Walkability has been conceived in different ways, such as proximity to destinations (McCormack and Shiell, 2011; Owen et al., 2004; Pikora et al., 2003); street-connectivity (Grasser et al., 2013; McCormack and Shiell, 2011; Saelens and Handy, 2008); light traffic and appropriate pedestrian infrastructure (McCormack and Shiell, 2011; Owen et al., 2004; Pikora et al., 2003; Saelens and Handy, 2008); pleasant aesthetics (Humpel, 2002; Owen et al., 2004; Pikora et al., 2003; Saelens and Handy, 2008); higher residential density (Grasser et al., 2013; McCormack and Shiell, 2011; Saelens and Handy, 2008); mixed land uses (Grasser et al., 2013; McCormack and Shiell, 2011); and safety (Pikora et al., 2003), all of which have shown associations with walking for both transportation and recreation. However, the diversity of conceptual and operational definitions across studies and indices (Schaefer-McDaniel et al., 2010) has resulted in poor generalizability for walkability research (Feng et al., 2010), and limited our ability to directly compare or aggregate study findings (Schopflocher et al., 2014).

1.2. Walk Score® as a walkability metric

Walk Score® is a proprietary metric that operationalizes the walkability of locations with a score from 0 to 100, based on walking

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destinations and some measures of pedestrian friendliness (Walk Score, 2015). Potential advantages of Walk Score® include rapid, inexpensive acquisition and greater comparability between locations (Carr et al., 2011; Chiu et al., 2015; Duncan et al., 2013). Potential disadvantages of Walk Score® include a lack of information about influential built environment variables like pedestrian infrastructure, aesthetics, cold weather climate-related impedance, and/or traffic information. The most common data sources for other walkability indices, namely, street-level systematic observations (neighborhood audits) (Schaefer-McDaniel et al., 2010) and Geographic Information Systems (GIS), however, are more time-consuming and expensive to collect, and provide only limited generalizability between studies (Feng et al., 2010).

Walk Score® is available for locations across the United States, Canada, Australia, and New Zealand, with more comprehensive commercial and research data obtainable from Walk Score® Professional (Walk Score, 2015). The producers of Walk Score® have continued to refine their metric; in 2011, Walk Score® launched the "Street Smart Walk Score" (hereafter referred to as Walk Score®) (Walk Score, 2015). The newest version of Walk Score® features a network-based algorithm (counting amenities along street routes versus straight line distances), provides additional consideration for depth of choice among amenities, and penalizes locations with lower pedestrian friendliness (Duncan et al., 2013; Frank and Ulmer, 2013; Walk Score, 2015).

1.3. Walk Score® research and field validation studies

A growing body of research has been conducted with Walk Score®, measuring its association with increases in different kinds of walking in communities (Hirsch et al., 2013, 2014; Manaugh and El-Geneidy, 2011), general physical activity levels (Cole et al., 2015; Thielman et al., 2015; Winters et al., 2015), and decreases in weight or body mass index (BMI) (Chiu et al., 2015). Notably, two large-scale Canadian studies based on surveys of over 100,000 participants, and controlling extensively for confounding variables, found higher Walk Scores® were associated with greater energy expenditure on walking for active transportation (Chiu et al., 2015; Thielman et al., 2015). Other recent Canadian studies have demonstrated higher Walk Scores® are associated with increases in utilitarian walking (Chudyk et al., 2015; Wasfi et al., 2015) and decreases in BMI (Wasfi et al., 2016), although one study found no association between Walk Scores® and daily steps measured by accelerometer (Hajna et al., 2015).

Field validations of Walk Score® can contribute necessary assurances of the metric's geographic validity, accuracy, and reliability. Indeed, walkability studies failing to reference an appropriate field validation are not considered geographically rigorous according to longstanding conventions in geospatial and cartographic research (Thornton et al., 2011). Two key field validation studies have examined how Walk Score® corresponds with objective measures of the built environment; one conducted with the previous version of Walk Score® in Rhode Island (Carr et al., 2010, 2011), and the other with the network-based Street Smart Walk Score across five highly urban regions of the United States (Duncan et al., 2011, 2013). With increasing refinement of the Walk Score® algorithm, such studies will need to contend with the geospatial complexity of the metric (Duncan et al., 2011, 2013). As use of Walk Score® expands outside of urban America, these studies should critically assess Walk Score® as a tool for community health promotion policies and interventions. The contribution of the current study to the research literature consists of a geospatially rigorous field validation of Walk Score® with systematic street-level observation data collected as part of the Community Health and the Built Environment (CHBE) project in three communities along a rural-urban continuum in the province of Alberta, Canada.

2. Methods

2.1. Systematic street-level observation: the Community Health and the Built Environment project

The Community Health and the Built Environment (CHBE) project (2007–2012) was a multi-community health promotion initiative in Alberta, Canada (Nykiforuk et al., 2013). From a socio-ecological perspective, CHBE examined how local environments contribute opportunities and barriers for community members' health and wellness (Nykiforuk et al., 2013). Four Alberta communities were partnered in the project, including Bonnyville, Medicine Hat and Redcliff,[1] North Central Edmonton, and St. Paul. In 2008, as part of the CHBE project, we conducted systematic street-level observations using a neighborhood audit tool which adapted the Irvine-Minnesota Inventory (IMI) (Boarnet et al., 2006; Day et al., 2006) with elements of the Systematic Pedestrian and Cycling Environmental Scan (Pikora et al., 2002) and Pedestrian Environmental Data Scan (Clifton et al., 2007) to incorporate additional data collection (such as bike lane information). Our CHBE-modified tool provided an opportunity for field observers to document both macro-scale and micro-scale features of the built environment, including urban design, traffic, pedestrian infrastructure, and the presence or absence of institutional, commercial, or recreational destinations (forming the basis for the Walk Score® field validation) (Nykiforuk et al., 2013). Three observers were trained with standardized manuals over a three-day workshop to administer the adapted tool (Schopflocher et al., 2014). Over 300 microscale observations were comprehensively documented and GIS mapped for both sides of every street segment in each community, using the National Road Network (NRN) data set in the North American Datum (NAD) 1983 Canadian Spatial Reference System (CSRS) Alberta 10 Transverse Mercator (TM) (Resource) projection (Government of Canada, 2014).

In 2015, relevant systematic street-level observation data were extracted from three CHBE communities to correspond with the 2181 data points available in Bonnyville, Medicine Hat, and North Central Edmonton provided as latitude longitude coordinates in a Walk Score® Professional data set for the province of Alberta, Canada. According to the metadata, over 95% of the Walk Scores® in the data set were derived in September 2010. The CHBE communities included for field validation corresponded to the most recent population centre designations from the Statistics Canada Census Dictionary 2011, and consisted of Bonnyville - small (between 1000 and 29,999 population), Medicine Hat - medium (between 30,000 and 99,999 population), and North Central Edmonton[2] - large (over 100,000 population) (Statistics Canada, 2011). In our research, the field validation study communities were further differentiated by spatial extent and road surface length, which were for Bonnyville 14.10 km^2 and 58.2 km, for Medicine Hat 112.01 km^2 and 353.9 km, and for North Central Edmonton 11.06 km and 165.1 km (City of Edmonton, 2015a; Statistics Canada, 2016).

2.2. Calculating Walk Score® with observational data

Walk Score® is scaled linearly, ranging from 0 to 24 "car-dependent" (car required for almost all errands), 25–49 "car-dependent" (car required for most errands), 50–69 "somewhat walkable" (car required for some errands), 70–89 "very walkable" (car not required for most errands), to 90–100 "walker's paradise" (car not required for errands) (Walk Score, 2012). Walk Scores® and component information

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[1] Medicine Hat and its suburb Redcliff were partnered in the Community Health and the Built Environment (CHBE) project as a single community.

[2] North Central Edmonton as partnered in the Community Health and the Built Environment (CHBE) project consists of eleven inner city communities in Edmonton (one of the two largest cities in Alberta); namely, Alberta Avenue, Boyle Street, Central McDougall, Cromdale, Delton, Eastwood, Elmwood Park, McCauley, Parkdale, Spruce Avenue, and Westwood with a combined population of approximately 41,000 within the greater Edmonton population of 782,000 (City of Edmonton, 2015a).

(intersection density and average block length) were extracted for Bonnyville (n = 171), Medicine Hat (n = 1166), and North Central Edmonton (n = 844), and locations were inputted into a geospatial database (ESRI, 2015). For each location in the geospatial database, the Walk Score® algorithm (Frank and Ulmer, 2013; Walk Score, 2012) was used to calculate a CHBE derived score using relevant indicators collected during street-level systematic observations (Walk Score, 2012)[3] and information from the NRN data set (Government of Canada, 2014).

Walk Score® is calculated by determining a raw score out of fifteen, normalizing that score from zero to one hundred, and deducting two penalties for low intersection density (ID) and high average block length (ABL) (Walk Score, 2012).

$$\text{Walk Score}® = \text{Raw Score}/15 \times 6.67 - (\text{ID} + \text{ABL})$$

The raw score is composed of nine amenity categories of walking destinations (grocery, restaurants, shopping, coffee shops, bank services, schools, entertainment, bookstores, and parks) each weighted from one to three points based on low, medium, or high importance for walking in six research articles referenced by Walk Score® (Cerin et al., 2007; El-Geneidy and Levinson, 2011; Iacono et al., 2010; Lee and Moudon, 2006; Moudon et al., 2006; Piekarski, 2009; Walk Score, 2012). Based on this literature, we selected indicators from the CHBE project for each amenity category (Table 1). Our indicator selection was straightforward for grocery, restaurants, coffee shops, bank services, schools, and bookstores. We included specialty food stores under shopping (Cerin et al., 2007; Lee and Moudon, 2006), all green spaces under parks (Cerin et al., 2007), and both cultural and sporting activities under entertainment (El-Geneidy and Levinson, 2011; Iacono et al., 2010).

Scores within each category were attenuated by a close approximation of the Walk Score® distance decay function awarding 100% of the possible maximum points to amenities located within a network walkshed distance of 0.25 miles (400 m or 5 min walk), 75% within 0.5 miles (800 m or 10 min), 40% within 0.75 miles (1200 m or 15 min), and 12.5% within 1.0 mile (1600 m or 20 min) of each location (Walk Score, 2012). The weighting of three categories (restaurants, shopping, and coffee shops) reflects the number of destinations available (or "depth of choice") (Walk Score, 2012). Finally, the Walk Score® intersection density (ID) function was used to deduct a maximum 5% penalty for <60 intersections per square mile[4] and the Walk Score® average block length (ABL) function was used to deduct the same maximum of 5% for >195 m length per block.[5]

An illustration depicting how the CHBE derived scores were calculated using ArcGIS geospatial software (ESRI, 2015) at an example location in North Central Edmonton is provided in Fig. 1. Destinations were awarded a proportion of the maximum raw score by network walkshed location. The intersection density (ID) and average block length (ABL) were calculated by drawing a mile square buffer around points, and counting the number of intersections, total block length, and number of blocks. Because the NRN data set renders an intersection and new block wherever roads diverge (Government of Canada, 2014), our intersection counts were likely higher, and our average block lengths were likely shorter than Walk Score®.

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[3] We obtained a methodology document that outlined the Walk Score® formula, amenity categories, "depth of choice" calculations, "distance decay" function, and penalty deductions by purchasing a Walk Score® Professional data set for the province of Alberta, Canada.

[4] In detail, the Street Smart Walk Score® ID penalty deducts 4% for 60–90, 3% for 90–120, 2% for 120–150, 1% for 150–200, and no penalty for over 200 intersections within the 1 mile² buffer (Walk Score, 2012).

[5] The Street Smart Walk Score® ABL penalty deducts 4% for 180–195 m, 3% for 165–180 m, 2% for 150–165 m, 1% for 120–150 m, and no penalty for under 120 m average block length within the 1 square mile buffer (Walk Score, 2012).

Table 1
Indicators used to calculate Street Smart Walk Score® raw scores by amenity categories as part of the Community Health and the Built Environment (CHBE) project systematic street–level observations from Bonnyville, Medicine Hat, and North Central Edmonton in 2008.

Walk Score® category	Maximum raw score (/15)	Systematic street-level observation indicators
Grocery	3	Grocery stores; ethnic food stores
Restaurants	3	Fast food counters/restaurants; full service/hotel/ethnic restaurants; banquet halls; outdoor dining; bars/nightclubs; other food outlets
Shopping	2	Big box shops; shopping malls; strip malls; bakeries; butcher shops; delicatessens; farmers' markets
Coffee shops	2	Coffee shops
Bank services	1	Commercial banks; financial services
Schools	1	Elementary/junior high schools; high schools; universities; other schools
Entertainment	1	Auditoriums/concert halls; theatres; museums; movie theatres; games rooms; gyms/fitness centres; indoor/outdoor hockey arenas; indoor/outdoor pools; wading pools; tennis courts; basketball nets; community gardens; other recreational spaces/public places
Bookstores	1	Bookstores; libraries
Parks	1	Playgrounds; spray decks; playing fields; open green spaces; golf courses; lakes/ponds; fountains/reflecting ponds; campgrounds; streams/rivers/creeks/canals; forests/woods; mountains/hills

2.3. Statistical analysis

Inter-rater reliability was evaluated for the systematic street-level observations by calculating Cohen's kappa across 64 segments coded by two observers on 52 categorical variables used to reverse-engineer Walk Score®. Kappa statistics were interpreted as slight agreement (0.00–0.20), fair agreement (0.21–0.40), moderate agreement (0.41–0.60), substantial agreement (0.61–0.80), and almost perfect or perfect agreement (0.81–1.00) (Hallgren, 2012). For the initial analysis, means and 95% confidence intervals for the overall Walk Scores®, overall CHBE scores, intersection density (ID), and average block length (ABL) were computed in each community, testing the hypothesized equality of means with paired Student's t-testing at the 0.05 alpha level. To measure the association between the Walk Scores® and CHBE scores, Spearman's Rank Correlation Coefficients (r_s) (Spearman, 1904) were calculated, given the non-normal distribution of this geospatial data set. Both of these analyses were conducted using the Stata statistical software package (StataCorp, 2015). Notably, walkability and other geospatial data sets are often characterized by spatial autocorrelation, since similar features of the built environment cluster (Clifford et al., 1989). Global Moran's I statistic was calculated using the Spatial Analysis in Macroecology (SAM) software package (Spatial Analysis in Macroecology [SAM], 2015) to evaluate spatial autocorrelation, determining that amenities clustering in the data sets influenced the null distribution of the product moment correlation coefficient (Clifford et al., 1989). To account for this positive spatial autocorrelation, the Clifford-Richardson adjustment (Clifford et al., 1989) was performed using geostatistical software (SAM, 2015) to reduce the estimated effective sample size, and thus the degrees of freedom of the t-statistic, with an inverse Euclidean distance weights matrix accounting for potentially inflated p-value significance (Rangel et al., 2010). We interpreted the strength of the correlations as low (<0.41), moderate (0.41–0.60), high (0.61–0.80) and very high (>0.81) (Prion and Haerling, 2014).

3. Results

Inter-rater reliability for the systematic street-level observations showed substantial agreement, with an average kappa of 0.76 (95% CI:
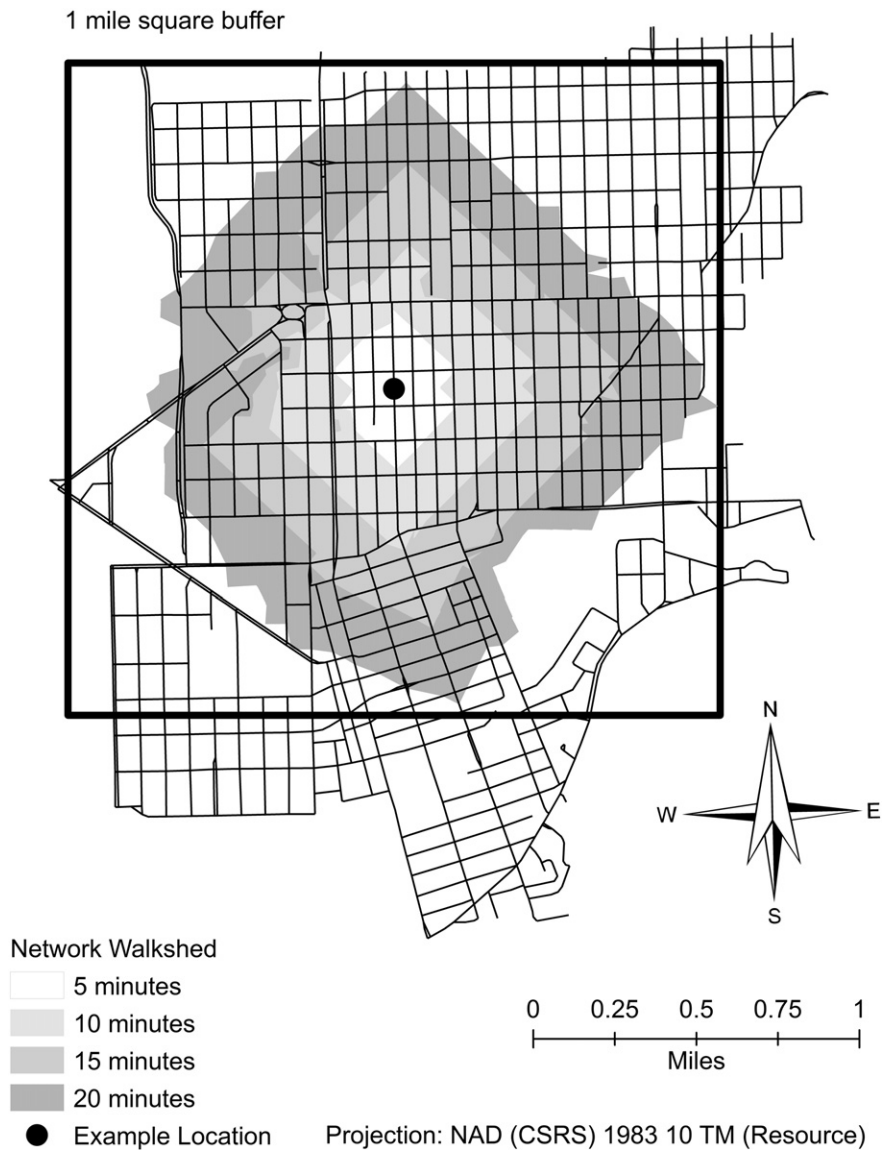
Fig. 1. Illustration of network walkshed and one square mile buffer at a location in North Central Edmonton for the Community Health and the Built Environment (CHBE) project systematic street-level observations collected in 2008.

Table 2
Mean scores, intersection density, and average block length for Bonnyville, Medicine Hat, and North Central Edmonton based on the Community Health and the Built Environment (CHBE) project systematic street-level observations in 2008 and Street Smart (SS) Walk Scores® generated in 2010.

	SS Walk Score®		CHBE Score		p-Value
	Mean	95% CI	Mean	95% CI	
Bonnyville					
Overall	40.8	(37.3, 44.3)	42.4	(39.1, 45.6)	0.003*
Intersection density	63.6	(60.0, 67.2)	150.1	(144.7, 155.6)	<0.001*
Average block length	225.8	(209.8, 241.8)	169.8	(165.3, 174.3)	<0.001*
Medicine Hat					
Overall	45.0	(43.5, 46.5)	39.3	(38.0, 40.6)	<0.001*
Intersection density	107.9	(106.1, 109.7)	366.4	(361.5, 371.7)	<0.001*
Average block length	153.2	(151.4, 155.0)	185.7	(184.5, 186.8)	<0.001*
North Central Edmonton					
Overall	76.6	(75.7, 77.5)	84.4	(83.3, 85.5)	<0.001*
Intersection density	116.0	(114.2, 117.9)	408.9	(401.3, 416.5)	<0.001*
Average block length	151.3	(150.2, 152.3)	146.2	(145.6, 146.8)	<0.001*

* Denotes statistical significance at $\alpha = 0.05$.

0.53–0.99). The overall mean of the Walk Scores® in each of the three communities indicated Bonnyville ($\mu = 40.8$, 95% CI: 37.3–44.3) and Medicine Hat ($\mu = 45.0$, 95% CI: 43.5–46.5) were "car-dependent", while North Central Edmonton ($\mu = 76.6$, 95% CI: 75.7–77.5) was "very walkable" (Table 2). Differences in mean Walk Score® and the CHBE scores for each of the overall scores, intersection density (ID), and average block length (ABL) were statistically significant across the three communities (Table 2).

Global Moran's *I* for scores indicated marginal spatial autocorrelation in Bonnyville (Walk Score® $I = 0.355$, p < 0.001; CHBE Score $I = 0.324$, p < 0.001), Medicine Hat (Walk Score® $I = 0.250$, p < 0.001; CHBE Score $I = 0.279$, p < 0.001), and North Central Edmonton (Walk Score® $I = 0.208$, p < 0.001; CHBE Score $I = 0.196$, p < 0.001). After applying the Clifford-Richardson adjustment, high to very high positive correlations were observed across the small, medium, and large population centre community types. The highest correlation was for Bonnyville ($r_s = 0.950$, p < 0.001, adjusted p < 0.001), followed by Medicine Hat ($r_s = 0.790$, p < 0.001, adjusted p < 0.001), and North Central Edmonton ($r_s = 0.763$, p < 0.001, adjusted p < 0.001) (Table 3).

Table 3
Global Moran's *I*, Spearman's correlation, significance, and adjusted significance for the scores in Bonnyville, Medicine Hat, and North Central (NC) Edmonton based on the Community Health and the Built Environment (CHBE) project systematic street-level observations in 2008 and Street Smart (SS) Walk Scores® generated in 2010.

	SS Walk Score®		CHBE Score		Spearman's *r*	p-Value	Adjusted p-value
	Moran's *I*	p-Value	Moran's *I*	p-Value			
Bonnyville	0.355	<0.001*	0.324	<0.001*	0.950	<0.001*	<0.001*
Medicine Hat	0.250	<0.001*	0.279	<0.001*	0.790	<0.001*	<0.001*
NC Edmonton	0.208	<0.001*	0.196	<0.001*	0.763	<0.001*	<0.001*

* Denotes statistical significance at α = 0.05.

4. Discussion

We undertook a geostatistical field validation of Walk Score® across three Canadian centres along a rural-urban continuum. Comparing Walk Score® to street-level systematic observations in three communities with different size, infrastructure, and population density, we observed high to very high correlations which suggest the Walk Score® metric provides a geographically valid assessment of walkability, comparable to more resource-intensive data collection methods. Nonetheless, since Walk Score® is primarily a destination-based metric, further exploration of how this walkability concept is predictively valid is warranted for application in health promotion policies and interventions between community contexts.

For example, Walk Score® has been criticized for lacking consideration of pedestrian infrastructure (Duncan et al., 2013; Hirsch et al., 2013), such as sidewalks, crosswalks, intersections, speed limits, traffic calming devices, seating, and aesthetics, which have demonstrated associations with transportation and recreation walking (Grasser et al., 2013; Humpel, 2002; Leslie et al., 2005; McCormack and Shiell, 2011; Pikora et al., 2003; Saelens and Handy, 2008). Nascent built environment research emphasizes a more comprehensive concept of streetscapes as activity spaces for walking (Perchoux et al., 2013; Silver and Nichols Clark, 2014), incorporating desirable amenities (or destinations) with suitable (pedestrian and transit) infrastructure, social capital (engagement and networks) and appropriate timing (both scheduling and seasonal) (Millward and Spinney, 2011). Walk Score® can be further criticized for emphasizing transportation walking as a derived demand of arriving at a destination, as opposed to viewing walking as a stand-alone recreational or leisure-time activity (Cao et al., 2008). Although Walk Score® incorporates amenity categories (shopping facilities, schools, and parks) where walking occurs, it does not measure walking at these destinations, nor permit researchers to distinguish what proportion of a Walk Score® derives from these versus more sedentary destinations. Arguably, Walk Score® assumes a contestable normative dimension, by assigning walking to the consumption of a particular set of goods and services (Lewis, 2012). These main criticisms bear out differently across the small, medium, and large population centres.

From a built environment perspective, it is clear that destinations are not uniformly distributed across different settlements. Empirically, our statistical testing demonstrated high to very high correlations between overall Walk Scores® and CHBE scores (Table 3), albeit significant differences between mean values for these scores, and for measures of intersection density (ID) and average block length (ABL) (Table 2). We attribute the very high correlation in Bonnyville to a smaller sample (n = 171) and geographic area (14.10 km²) with fewer overall destinations, which is demonstrated as higher spatial autocorrelation observed for Moran's *I* compared to the other communities (Table 3). Our use of the NRN data set likely made the most substantial contribution to significant differences between the mean overall Walk Scores® and CHBE scores, since it presents relatively more intersections and blocks for calculations.

From a logistical perspective, destination-based walkability may be easier to implement in large population centres comprising older, inner city neighborhoods like North Central Edmonton, with its mixed land uses, gridded street networks, and high levels of pedestrian connectivity (Nykiforuk et al., 2015). Greater challenges exist for destination-based walkability in medium population centres like Medicine Hat, which are dominated by more proportionately suburban built environments with automobile-centric street networks and sprawling and separated land uses. Once established, suburban neighborhoods are often more easily retrofitted with walking infrastructure that emphasizes recreational use (foot paths, walking trails, greenspaces) (Schasberger et al., 2009) as opposed to transportation use (amenities as destinations) (Randall and Baetz, 2001). Smaller population centres like Bonnyville, where streetscapes have traditionally serviced dispersed outlying populations (Bryant and Joseph, 2001), typically have longer block lengths (Evenson et al., 2009), higher speed limits (Evenson et al., 2009; Frost et al., 2010), less street lighting (Evenson et al., 2009; Frost et al., 2010; Kegler et al., 2013), and fewer sidewalks (Evenson et al., 2009; Frost et al., 2010; Kegler et al., 2013) than in metropolitan regions, posing additional barriers for implementing destination-based walkability in rural areas. Active transportation research in Canada demonstrates that the large distances between destinations make rural populations likelier to drive and less likely to walk to destinations than their urban counterparts (Butler et al., 2007).

Potentially normative dimensions of Walk Score® will also almost certainly bear out differently in developing effective health promotion policies and interventions across municipal types. Some walkability researchers have argued that destinations promote opportunities for social interaction (El-Geneidy and Levinson, 2011); however, promoting walking access to the slate of goods and services measurable with Walk Score® (grocery stores, coffee shops, restaurants, banks, schools, shopping, bookstores, parks, and entertainment) may not fully capture socio-economic, cultural, and/or lifestyle diversity and equity considerations. Despite its high Walk Scores®, socio-demographic factors associated with low levels of social capital (and less walking) tend to cluster in North Central Edmonton. These factors include higher crime rates, lower housing prices, higher residential transience, and lower median household income (Statistics Canada, 2015) than City of Edmonton averages (City of Edmonton, 2015b). Although very little peer-reviewed research exists, Walk Score® was found to be positively correlated with crime rates in Rhode Island, perhaps because gridded street networks and clusters of retail services can be found in older, more densely populated, inner city areas (Carr et al., 2010). Ethnic and linguistic diversity in inner city neighborhoods also complicates conceptualizing and operationalizing walkability based on Walk Score®. In suburban areas like Medicine Hat, improving destination-based walkability runs up against the geographic scale, legal constraints, and lifestyle aspirations associated with residing in these types of settlements (Grant and Scott, 2012); as such, modifying the built environment can be both economically and politically costly (Filion et al., 2015). In small population centres like Bonnyville, which tend to have very different physical activity profiles compared with metropolitan regions (Kegler et al., 2013; Millward and Spinney, 2011), the emerging research indicates that residents disagree with their more urban counterparts on the nature of a walkable built environment (Schasberger et al., 2009), and tend to place a much lower priority on walking for transportation (Barnidge et al., 2013; Doescher et al., 2014; Frost et al., 2010).

Given the complexities of implementing destination-based walkability, Walk Score may differ in its utility for supporting the full range of approaches to improve walkability along the rural-urban continuum. In inner cities, destination-oriented active transportation is frequently more important to residents than recreational walking (Millward and Spinney, 2011). Walk Score® can be a highly useful metric for built environment modification in these settings, since increasing inner city amenities can support active transportation, and provide higher tax revenues for community development (O'Connell, 2009). In the suburban context, researchers have argued for form-based zoning (Lemmens, 2009) and public participation in planning processes (Resnik, 2010) to improve pedestrian walksheds, promote commercial and residential densification and infill, and provide more accessibility to public transit (Filion et al., 2015). Since these broader interventions need to occur at the earliest stages of development, it may be more appropriate to focus walkability interventions on safety, pedestrian infrastructure, and aesthetics in existing suburban areas, retrofitting wherever possible. For small population centres, walkability is still early in the first generation of research (Frost et al., 2010); indeed, CHBE data collected for two additional municipalities in Alberta could not be used for the field validation, owing to an insufficient number of locations provided by Walk Score® Professional for those communities (Redcliff n = 1; St. Paul n = 4). What is becoming more clear in rural communities, however, is that residents are likelier to prioritize pedestrian infrastructure (Doescher et al., 2014; Yousefian et al., 2010), ease of travel (Bernhard et al., 2013), and positive aesthetics (Doescher et al., 2014; Frost et al., 2010) as part of a recreationally focused walkability concept (Schasberger et al., 2009). Thus walkability interventions in rural centres might focus on improving safety and pedestrian infrastructure in built up areas, and increase the accessibility of walking paths as recreational destinations.

4.1. Study limitations and strengths

A potential limitation of our study was the need to approximate amenity categories with CHBE indicators based on our careful evaluation of the literature review directly provided by Walk Score® (Frank and Ulmer, 2013; Walk Score, 2012). Notably, there was a small but arguably negligible degree of temporal disparity between the 2010 Walk Score® and 2008 CHBE data sets. Key strengths of the study include the methodological rigour of validating Walk Scores® against street-level systematic observations, and critical assessment of Walk Score® as informing policies and interventions across the three settlement types (Duncan, 2013). As an extension of previous validation studies (Carr et al., 2010, 2011; Duncan et al., 2011, 2013), this field validation employed network-based Walk Score® (Frank and Ulmer, 2013; Walk Score, 2012) and accounted for spatial autocorrelation (Clifford et al., 1989) of the data set.

5. Conclusion

This research presents a successful effort to field validate Walk Score® outside of urban America using systematic street-level observations, providing greater assurance to researchers employing Walk Score® in a Canadian context. Walk Score® has the potential to benefit walkability research by providing a low-cost, easily accessible metric with a high degree of generalizability (Carr et al., 2011; Chiu et al., 2015; Duncan, 2013). Many research studies that examined Walk Score® have reported significant associations with various forms walking (Chudyk et al., 2015; Hirsch et al., 2013, 2014; Manaugh and El-Geneidy, 2011; Wasfi et al., 2015), physical activity more generally (Thielman et al., 2015; Winters et al., 2015), and overweight and obesity (Chiu et al., 2015; Wasfi et al., 2016). However, from a health promotion perspective, critical assessment of Walk Score® and its suitability for different municipal types is needed to better leverage these demonstrated associations into appropriate community-based walkability policies and interventions.

Conflicts of interest

None.

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