QUANTITATIVE RESEARCH

Creating Neighbourhood Groupings Based on Built Environment Features to Facilitate Health Promotion Activities

Donald Schopflocher, PhD,[1] Eric VanSpronsen, MPH,[1] John C. Spence, PhD,[2] Helen Vallianatos, PhD,[3] Kim D. Raine, PhD,[1] Ronald C. Plotnikoff, PhD,[4] Candace I.J. Nykiforuk, PhD[1]

ABSTRACT

Objectives: Detailed assessments of the built environment often resist data reduction and summarization. This project sought to develop a method of reducing built environment data to an extent that they can be effectively communicated to researchers and community stakeholders. We aim to help in an understanding of how these data can be used to create neighbourhood groupings based on built environment characteristics and how the process of discussing these neighbourhoods with community stakeholders can result in the development of community-informed health promotion interventions.

Methods: We used the Irvine Minnesota Inventory (IMI) to assess 296 segments of a semi-rural community in Alberta. Expert raters "created" neighbourhoods by examining the data. Then, a consensus grouping was developed using cluster analysis, and the number of IMI variables to characterize the neighbourhoods was reduced by multiple discriminant function analysis.

Results: The 296 segments were reduced to a consensus set of 10 neighbourhoods, which could be separated from each other by 9 functions constructed from 24 IMI variables. Biplots of these functions were an effective means of summarizing and presenting the results of the community assessment, and stimulated community action.

Conclusions: It is possible to use principled quantitative methods to reduce large amounts of information about the built environment into meaningful summaries. These summaries, or built environment neighbourhoods, were useful in catalyzing action with community stakeholders and led to the development of health-promoting built environment interventions.

Key words: Built environment; quantitative methods; health promotion; knowledge exchange; obesity reduction

La traduction du résumé se trouve à la fin de l'article.

Can J Public Health 2012;103(Suppl. 3):S61-S66.

In Canada, chronic diseases as leading causes of death are linked by common preventable risk factors related to lifestyle: tobacco use, unhealthy diet and physical inactivity.[1] Recent research suggests that prevention efforts should target these risk factors and environmental, economic, social and behavioural determinants of health.[1-3] Specifically, the built environment (BE) is implicated as an important consideration for interventions focused on risk factors as well as health determinants.

The relevance of the BE to prevention and reduction of adverse health outcomes associated with chronic disease is clear in research on obesogenic environments[4-9] and on physical activity.[10-13] Research on obesogenic environments is predicated on the idea that obesity is a normal response to an abnormal environment and that understanding, *measuring* and altering that environment is central to intervention success.[5] This is consistent with the settings-based strategy of the Ottawa Charter, calling for environments that make the healthy choice the easy choice.[14] Within every community there is interaction between individuals, micro- and macro-environments[6] and types of environment (physical, economic, social and political). These interactions shape what (healthy) choices are available. It follows that examination of the environment should facilitate identification of factors amenable to intervention. Yet there is no consensus on how to measure environments or on specific factors that might be changed to improve health. This quandary is exacerbated in small or rural municipalities that do not have administratively defined neighbourhoods, which typically form the basis for measurement in larger urban areas.

Recent "state of the science" articles provide critical analyses of existing measures for documenting the impact of BE on physical activity and healthy eating.[15,16] These reviews indicate that the field has not progressed beyond simple description of variables and their associations. Few analysis techniques have been identified to aggregate or to summarize these measures and thereby stimulate theory construction. The Irvine-Minnesota Inventory (IMI) provides an example; it is a comprehensive measure of macro- and micro-level BE characteristics that may be linked to physical activity.[17] The IMI seeks ratings of 164 characteristics for each road segment (two facing sides of one street block) in a given setting. At the time of data analysis for the current paper, there were no published methods for summarizing the very large amount of data that result from use of the IMI.

Author Affiliations

1. Centre for Health Promotion Studies, School of Public Health, University of Alberta, Edmonton, AB
2. Faculty of Physical Education and Recreation, University of Alberta, Edmonton, AB
3. Department of Anthropology, Faculty of Arts, University of Alberta, Edmonton, AB
4. School of Education, University of Newcastle, NSW, Australia

Correspondence: Dr. Candace Nykiforuk, 3-300 ECHA, 11405-87 Ave., Edmonton, AB T6G 1C9, Tel: 780-492-4109, Fax: 780-492-0364, E-mail: candace.nykiforuk@ualberta.ca
Acknowledgements: Funding for this project was provided to C. Nykiforuk by grants from the Heart and Stroke Foundation of Canada in partnership with the Canadian Institutes of Health Research (CIHR). K. Raine and R. Plotnikoff are supported by the CIHR Applied Research Public Health Chair Program. Raine's Chair is funded by the Heart and Stroke Foundation of Canada. We thank Laura Nieuwendyk for conducting the community assessment and our community partners for their participation and support.
Conflict of Interest: None to declare.

This paper aims to 1) present a quantitative method for summarizing the information from comprehensive environmental inventories such as the IMI, and 2) demonstrate how these summaries can contribute to dialogues with communities for the development of health promotion interventions.

METHODS

Background

This paper reports on a subproject of the Community Health and the Built Environment (CHBE) project, which worked in partnership with communities to promote physical activity and healthy eating by identifying and overcoming barriers in the built environment.[18] The CHBE project included expert assessment of the BE, followed participatory research principles,[19] and employed active and passive knowledge exchange[20] to ensure that findings and interventions were meaningful for public health practice and policy at community and regional levels. BE groupings were undertaken for this community because it did not have administratively defined neighbourhoods to support characterization of the BE analyses. The data presented here were collected in the town of Bonnyville, a semi-rural community located in Alberta; the town's population was 5,832, within a municipal district population of 10,194.[21]

Ethical clearance for the project was received from the Health Research Ethics Board (Panel B), University of Alberta.

Rating procedure

In the summer and fall of 2008, three community observers were trained to use an adapted version of the IMI (which included an additional 30 variables) to document 3,786 segments in four Alberta communities (a full description of tool adaptations is available elsewhere[18]). In Bonnyville, all segments (n=296) were rated by one observer. Ratings were registered on a Motorola MC35 handheld computer running CyberTrack (v3.129) software. A Global Positioning System (GPS) reading was taken at the midpoint of each segment.

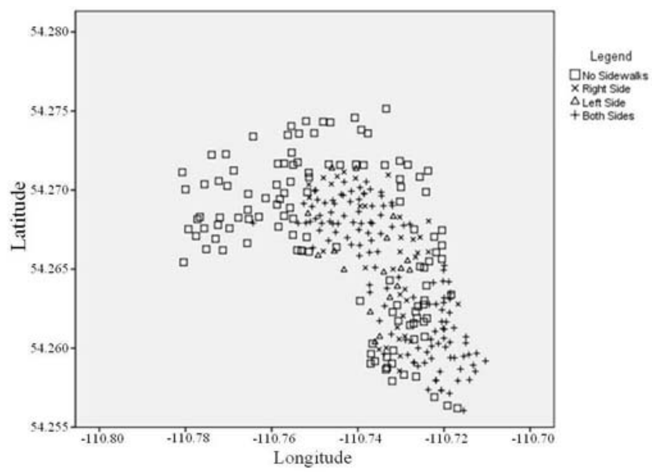
Analysis

A method of analysis was developed to reduce the information from the IMI ratings to manageable proportions and allow it to be effectively communicated. In the first phase, six expert raters were presented with representations of IMI data and then requested to use this information to create a set of groupings of geographically contiguous segments by assigning each segment to a single group (or "neighbourhood" based on BE characteristics). In the second phase, these experts' groupings were themselves analyzed by cluster analysis to form a single consensus grouping. In the third phase, a discriminant function analysis was performed on the consensus groupings using the items of the IMI to form meaningful scales of items that separated the groupings (BE neighbourhoods).

Phase one: Rater groupings

Since a GPS reading had been taken at each segment, it was possible to plot data from all 296 segments for each IMI variable on a separate two-dimensional longitude and latitude plot. Thus the spatial relations between segments were maintained. For variables with multiple response categories, each category was represented by a different symbol, and a legend was provided for each plot. The set of 197 plots (representing all original IMI and additional variables) was presented to the six raters. Figure 1 shows an example plot. Here, the four symbols differentiate the 296 segments on the basis of having "No Sidewalks", a sidewalk on one side of the street, or having sidewalks on "Both Sides" of the street.

Figure 1. Latitude and longitude plot of sidewalk presence on the 296 segments observed in the town of Bonnyville



Adapting a sorting method used in multivariate research[22] to the current task, we asked each rater to use the information from the complete set of plots to form a number of mutually exclusive and jointly exhaustive groupings of segments in Bonnyville so that each grouping represented a relatively homogenous region. No particular number of groupings was requested. Each rater was provided with a number of plots marked only by the GPS coordinates on which to draw their provisional and final groupings. The raters consisted of the observer of the Bonnyville segments and five other members of the multidisciplinary research team.

Phase two: Consensus groupings

Each group for each rater was translated into a binary variable indicating which segments were present in the grouping. Each rater provided either eight or nine groupings, and this resulted in a total of 51 separate grouping vectors. These 51 vectors were the variables used to form a consensus grouping. A hierarchical cluster analysis using Ward's method on squared Euclidean distances[23] was conducted with SPSSv15. Several solutions were examined, and ultimately the solution with 10 groups was chosen for further analysis. This procedure reduced the number of rated areas to be considered from 296 to 10.

Phase three: Discriminant function analysis

The IMI variables were then examined to determine whether they were suitable for inclusion in a discriminant function analysis.[24] Continuous variables and binary variables remained untransformed, but categorical variables were transformed into sets of binary variables prior to inclusion. This resulted in 796 variables for analysis. A stepwise discriminant function analysis was conducted using SPSSv15 to determine the variables that maximally separated the 10 groups in the consensus grouping. For purposes of interpretation, the result-

Figure 2. Consensus groupings of segments on a latitude-longitude plot and transposed onto a road network map

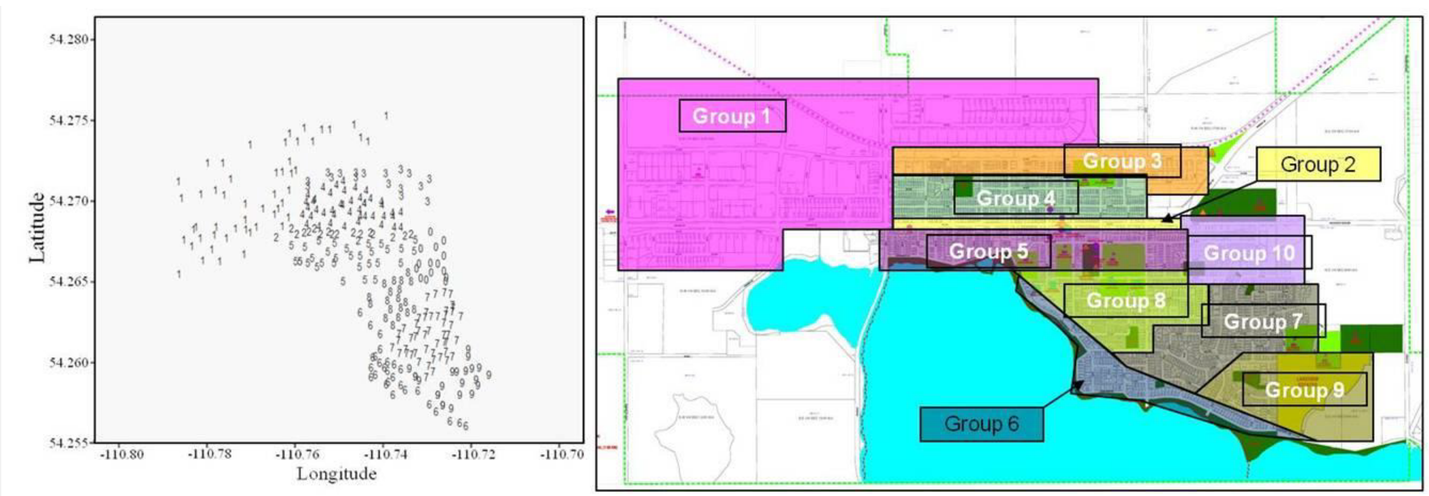


Table 1. Correlations of IMI Items With Discriminant Functions

Variable Name	Figure 4 Label	Discriminant Function								
		1	2	3	4	5	6	7	8	9
Mobile/manufactured home	MobileHome	0.05	-0.05	0.73	0.17	-0.01	-0.05	0.28	0.12	-0.24
Residences for seniors	SeniorRes	0.10	0.09	-0.08	0.21	0.11	-0.64	-0.42	0.19	-0.18
Single-family detached houses	SingleFam	0.80	0.29	-0.09	0.03	-0.09	0.10	-0.08	-0.13	0.02
Single-family duplex	Duplex	0.12	-0.06	0.30	0.14	0.06	-0.09	-0.02	0.20	0.05
High school	HighSchool	0.07	0.02	-0.15	0.29	0.22	0.32	0.09	0.36	0.02
Med/heavy industry	Industry	-0.84	0.17	0.03	-0.05	-0.01	-0.04	0.06	0.06	-0.02
Lake	Lake	0.18	0.14	-0.20	0.02	0.54	0.08	0.57	-0.12	0.04
White painted lines	PaintedLines	0.10	0.01	0.27	-0.08	-0.05	0.05	-0.04	0.09	0.07
Blank walls	BlankWalls	-0.23	-0.03	-0.03	0.34	0.10	0.30	-0.21	-0.31	-0.18
On-street parking	OnStrPk	0.92	-0.07	-0.02	0.04	-0.04	0.01	0.04	0.08	0.11
Speed bump/hump/dip*	TrafficCalm	-0.12	0.03	0.00	-0.02	-0.01	-0.02	0.04	0.06	0.01
Interesting architecture	Arch	0.65	0.33	-0.25	-0.28	0.39	-0.01	0.08	0.02	-0.13
Easy for walking	EasyWalk	0.64	-0.19	-0.22	-0.05	-0.26	-0.07	-0.01	0.15	-0.21
Road markers	Markers	0.01	-0.09	-0.13	0.41	0.26	0.33	-0.14	-0.02	-0.16
No curb cuts	NoCurbCuts	-0.27	0.42	0.46	-0.32	0.27	-0.11	0.03	-0.17	0.51
Pedestrian-activated signal	PedActSignal	0.02	-0.65	-0.16	-0.01	0.02	-0.15	0.02	0.02	0.02
Safe to cross	SafetoCross	0.36	0.55	-0.03	-0.10	-0.21	0.01	0.29	-0.01	-0.14
Convenient to cross	ConvenCross	0.38	-0.09	-0.35	0.16	-0.27	0.07	0.17	0.40	-0.23
Decorative sidewalk	SWDec	-0.06	-0.72	-0.10	-0.13	0.11	-0.13	0.03	0.05	0.07
Sidewalk in good condition	SWGood	0.33	-0.29	-0.08	-0.48	-0.16	0.35	-0.31	0.38	-0.14
Narrow sidewalk	SWDNarrow	0.46	0.17	-0.11	0.04	-0.54	0.10	-0.24	0.07	0.07
Shade from trees	TreeShade	0.47	0.16	-0.23	0.37	-0.31	-0.01	-0.17	0.14	0.17
Landscaping	Landscaping	0.60	0.56	-0.19	-0.13	0.19	0.00	-0.13	0.22	0.09
Highway	Highway	-0.24	0.05	0.02	-0.01	0.02	0.00	-0.02	-0.02	-0.01

* This variable does not appear in the figures.

ing discriminant functions were calculated, and correlations between them and IMI variables as well as the vectors specifying each of the 10 groupings were calculated. As an aid to interpretation, biplots (two-dimensional graphs) of these correlations containing markers for both groups and variables were examined.[25]

Phase four: Community Working Group (CWG) workshops

We believe the methods detailed above provided a meaningful reduction of the information from the IMI assessment of Bonnyville into a form that could be effectively communicated to community partners, especially in this community, which did not have administratively defined neighbourhoods. We now wished to: 1) determine whether the partners would find these results compelling and valid; 2) discover how our partners would characterize the groupings and whether this would provide additional information about the groupings not captured by the IMI (i.e., based on the expert knowledge of people local to the community); and 3) elucidate whether the information would prove useful in planning health promotion interventions with the community.

At a regular meeting of the Bonnyville CWG (CHBE's community partners) in spring of 2009, a workshop was held to discuss the results of the IMI assessment. We began by requesting that the CWG members each conduct their own grouping task using just their own local knowledge and then describe the groupings that emerged. A preliminary facilitated discussion with CWG members identified some types of information that might be considered when dividing the community into groupings. The CWG was then divided into two separate groups of four members each to independently create their groupings on an area map provided by the research team.

RESULTS

Analytic groupings

Figure 2 presents the 10 consensus groups from the cluster analysis of the individual ratings and, to convey perspective, also portrays the groupings on a road map.

The stepwise discriminant function analysis provided 24 statistically significant variables to separate the 10 groupings. All of the

Table 2. Correlations of Group Membership Vectors With Discriminant Function

Group	Discriminant Function								
	1	2	3	4	5	6	7	8	9
1	-0.87	0.16	0.00	-0.09	-0.05	-0.08	0.11	0.14	0.01
2	-0.03	-0.85	-0.09	-0.10	0.09	-0.08	0.01	0.02	0.02
3	-0.25	0.00	0.10	0.16	0.20	0.19	-0.30	-0.36	-0.05
4	0.17	-0.02	-0.21	0.26	-0.53	0.00	0.13	-0.20	-0.03
5	0.16	0.04	-0.22	0.39	0.26	0.34	0.07	0.26	0.01
6	0.23	0.19	-0.11	-0.21	0.36	-0.14	0.32	-0.23	0.01
7	0.27	0.12	0.13	-0.27	-0.10	0.08	-0.19	0.06	0.34
8	0.17	0.13	-0.09	0.21	0.10	-0.51	-0.24	0.10	-0.07
9	0.20	0.07	-0.04	-0.42	-0.08	0.16	-0.12	0.11	-0.31
10	0.14	-0.08	0.71	0.16	0.00	-0.03	0.14	0.05	-0.08

9 possible discriminant functions were statistically significant, and the canonical correlations ranged from 0.96 to 0.44. These discriminant functions correctly classified 80.7% of segments to the consensus groupings. Table 1 presents the correlations between the discriminant functions and the 24 variables included in the stepwise analysis.

Table 2 presents the correlations between the group vectors and discriminant functions for the 10 groups in the consensus groupings.

To demonstrate the interpretation of these tables, we note from Table 1 that the variables “Single family residences”, “On-street parking”, “Interesting architecture”, “Easy for walking” and “Landscaping” are highly positively correlated and that the presence of “Medium/heavy industry” is highly negatively correlated with Function 1. Table 2 shows a strong negative correlation between Function 1 and Group 1. This suggests a higher proportion of industrial land uses in Group 1 and a relative absence of single-family homes, on-street parking, interesting architecture, easy walking and attractive landscaping. Making interpretations of this type can be greatly simplified by examining pairwise graphs such as Figure 3, which plots the variable and group correlations from Tables 1 and 2 for Functions 1 and 2 on the same graph.

Where variables and groupings are located close to each other on a dimension, this can be interpreted as showing that the variable is characteristic of the grouping. Alternatively, variables located at a greater distance from a group demonstrate that the grouping is not associated with having high values on the given variable.

We briefly summarize interpretations of the remaining functions below. Function 2 differentiates Group 2 from the other groups by the presence of fair sidewalks and pedestrian-activated signals. Function 3 differentiates Group 10 from the other groups by having mobile homes. Function 4 differentiates Groups 6, 7 and 9 from Groups 4, 5 and 8 by having attractive architecture, good sidewalks and not having curb cuts, and by the absence of tree shade, convenient intersection crossings, seniors’ residences, high schools and blank walls. Function 5 differentiates Group 4 from Groups 3, 6 and 8 on the basis of convenient intersection crossings, tree shade, easy walking and narrow sidewalks, and the absence of curb cuts, nice architecture and lake proximity. Function 6 differentiates between Group 8 and Groups 3 and 5 according to the presence of seniors’ residences and the absence of good sidewalks, blank walls and neighbourhood markers. Function 7 contrasts lake proximity with proximity to seniors’ residences and thereby separates Groups 4 and 6 from Group 8. Function 8 distinguishes Group 5 from the other groups by the presence of high school(s), good sidewalks and convenient crossings (most completely from Groups 3, 4 and 6, in which these features are absent). Finally, Function 9 distinguishes between Groups 7 and 9 primarily on the basis of the presence of curb cuts.

CWG groupings

Overall, there was considerable agreement between the groupings and descriptions generated by the CWG and those generated by our analytic methods. Elements that were common included: grid-style development (e.g., well-connected sidewalks, shorter routes); spaghetti roadways (e.g., cul-de-sacs, longer routes); beautification (e.g., street flowers, bricked sidewalks, sidewalk lighting); pedestrian-friendly design (e.g., marked crosswalks, curb cuts); and sidewalk presence. Descriptors that were not directly captured through the IMI assessment but that the CWG considered important included characteristics of: traffic (e.g., volume and speed); wheelchair friendliness; locally owned establishments; historic references (e.g., development eras); population characteristics (e.g., age, socio-economic features, friendliness); housing styles (e.g., unique heritage houses, bland subdivision houses); and future community developments.

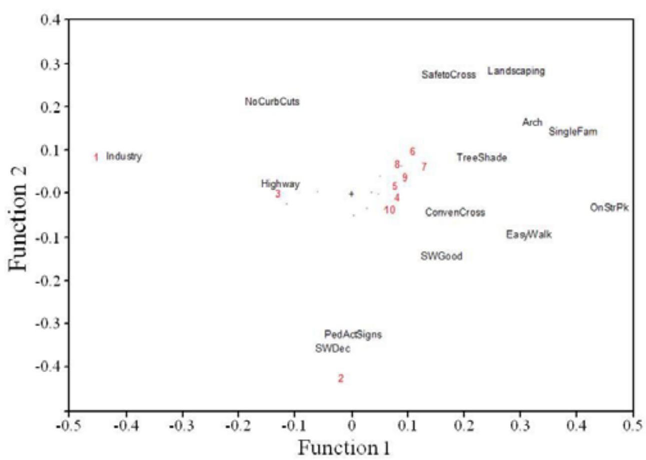
We then presented the results of our analytic methods to the CWG for its feedback. The similarity between the results of the CWG analysis and of the analytic methods was noted immediately. However, specific characteristics of our analytic methods were also praised. For example, the CWG was quick to validate the distinctions between Group 10 and Group 7, which neither CWG subgroup had noted in its own groupings.

DISCUSSION

Knowledge exchange between the analytic team and CWG was important for dissemination of research results, but it also provided opportunity for the validation of those results. On one hand, the groupings, initially created according to their composition of BE features by the research team (an “outsider” view), were demonstrated to have community relevance. On the other hand, contextual information provided by partners (an “insider” view) considerably enhanced the interpretation of the groupings for the research team. The insider view provided details about the BE that could not be readily, if at all, observed from the street level, suggesting an inherent flaw in observational studies of this kind. We argue that modification of tools like the IMI should explicitly include a process by which communities can add their own descriptors or a process that at least explores other insider sources of information. This would increase utility of the results for the communities, and for those interested in participatory research would help to solidify relationships with partners.

The process of information sharing and discussion was critical to identifying the priority for community intervention. Near the end of the workshop, a CWG member noted that one community grouping contained a cluster of residences in which seniors lived. It was also noted that this and the adjacent groupings had a low-quality sidewalk network (e.g., poor condition; low sidewalk pres-

Figure 3. Biplot of discriminant Functions 1 and 2*



* Variables with small factor loadings are not shown.

ence; poorly connected sidewalks), and, as a result, seniors living in that "neighbourhood" would experience difficulty accessing various community destinations necessary for their daily lives. From this discussion, CWG members formed the concept of *"you can't get there from here"* to encapsulate the idea that if the area where you live is not connected to destinations via a sidewalk network of high(er) quality, the likelihood that you would choose to walk to those destinations would be decreased. The CWG decided to have a map created to show high-quality walking routes and to install benches at key locations on these routes to allow seniors to rest while in active transit. Members of the CHBE team have since developed that map and undertaken installation of benches in partnership with the CWG.

Overall, we believe the analytic methods used to summarize the BE assessment were sufficiently accurate and compelling to provide a useful context for a dialogue between the research team and the CWG. This dialogue allowed a bidirectional flow of information that enhanced understanding on both sides and also directly facilitated action by contributing to the creation of an intervention with the potential to enhance the health and well-being of the community.[18,19] Creating neighbourhood groupings based on BE features is particularly useful for smaller or semi-rural communities that do not employ traditional administrative neighbourhood boundaries and for larger communities that want to define neighbourhoods in a geographically meaningful way when developing and implementing health promotion activities.

To our knowledge, we are the first research group to explore a method for reducing data related to micro-features of the BE for the purposes of health promotion intervention and creating dialogue with community stakeholders. The approach extends traditional geographic analyses of BE data[26-29] that explore relations between health and place. This paper contributes analytic and participatory techniques that can be paired or used independently to communicate how non-administratively defined areas vary. These BE neighbourhoods can be compared to determine the potential each area has for interventions to support health. From this, the type and location of interventions can be prioritized and stakeholder engagement fostered.[30]

Much remains to be done. It is unclear whether the discriminant functions derived by our analytic methods reflect general BE characteristics or whether they are specific to semi-rural communities in Alberta or even to the town of Bonnyville. Thus, future work will extend these methods to other Alberta communities. Systematic observation exercises can be costly and time-intensive, especially if a community does not have the resources for extensive training or the analytic capacity to deal with the resultant dataset. Thus, exploring the relative importance of individual variables across communities will inform the development of observation tools that collect a reduced number of variables. A condensed tool would greatly increase the ability of a community to collect these data outside of a research partnership. We also intend to formalize the community workshop process to obtain useful quantitative data to further examine the validity of groupings. In the current research we did not have access to individual health information from residents in order to determine whether living within a particular area has implications for health or healthy activity. We intend to examine this question in future research as well.

CONCLUSIONS

This project has demonstrated that it is possible to use principled quantitative methods to reduce large amounts of BE information, collected using inventories such as the IMI, into meaningful summaries. These summaries, or BE neighbourhoods, are inherently valuable for initiatives bridging municipal planning and community health. Ideally, they can be enhanced and contextualized by local knowledge provided by community stakeholders through methods of participatory research. We have also demonstrated that the overall research process can catalyze discussion among community stakeholders for the purposes of developing interventions into the built environment to promote health at the community level.

REFERENCES

1. World Health Organization. Global Status Report on Noncommunicable Diseases 2010. Description of the Global Burden of NCDs, Their Risk Factors and Determinants, 2011. Available at: http://www.who.int/nmh/publications/ncd_report2010/en/index.html (Accessed December 21, 2011).
2. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. *Cochrane Database Syst Rev* 2011;12.
3. Wall M, Hayes R, Moore D, Petticrew M, Clow A, Schmidt E, et al. Evaluation of community level interventions to address social and structural determinants of health: A cluster randomised controlled trial. *BMC Public Health* 2009;28(9):207-17.
4. Raine K, Spence JC, Church J, Boulé N, Slater L, Marko J, et al. State of the Evidence Review on Urban Health and Healthy Weights. Ottawa, ON: Canadian Institute for Health Information, 2008.
5. Egger G, Swinburn B. An ecological approach to the obesity pandemic. *BMJ* 1997;315:477-80.
6. Swinburn B, Egger G. Preventive strategies against weight gain and obesity. *Obes Rev* 2002;3:289-301.
7. Booth KM, Pinkston MM, Carlos Poston WS. Obesity and the built environment. *J Am Diet Assoc* 2005;105(5 Suppl 1):S110-17.
8. Cummins S, Macintyre S. Food environments and obesity – Neighborhood or nation? *Int J Epidemiol* 2006;35(1):100-4.
9. Kumanyika SK, Obarzanek E, Stettler N, Bell R, Field AE, Fortmann SP, et al. Population-based prevention of obesity: The need for comprehensive promotion of healthful eating, physical activity, and energy balance. A scientific statement from American Heart Association Council on Epidemiology and Prevention, Interdisciplinary Committee for Prevention (formerly the expert panel on population and prevention science). *Circulation* 2008;118(4):428-64.
10. Duncan MJ, Spence JC, Memmery WK. Perceived environment and physical activity: A meta-analysis of selected environmental characteristics. *Int J Behav Nutr Phys Act* 2005;2:11-20.
11. Spence JC, Plotnikoff RC, Rovniak LS, Martin Ginis KA, Rodgers W, Lear SA. Perceived neighbourhood correlates of walking among participants visiting the *Canada On the Move* website. *Can J Public Health* 2006;97(Suppl 1):S36-40.

12. Frank LD, Schmid TL, Sallis JF, Chapman J, Saelens BE. Linking objectively measured physical activity with objectively measured urban form: Findings from SMARTRAQ. *Am J Prev Med* 2005;28(2 Suppl 2):117-25.
13. Hoehner CM, Brennan Ramirez LK, Elliott MB, Handy SL, Brownson RC. Perceived and objective environmental measures and physical activity among urban adults. *Am J Prev Med* 2005;8(2 Suppl 2):105-16.
14. The Ottawa Charter for Health Promotion. Ottawa: Health and Welfare Canada, 1986. Available at: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/print.html (Accessed December 21, 2011).
15. Brownson RC, Hoehner CM, Day K, Forsyth A, Sallis JF. Measuring the built environment for physical activity: State of the science. *Am J Prev Med* 2009;36(Suppl 4):S99-123.
16. Lytle LA. Measuring the food environment: State of the science. *Am J Prev Med* 2009;36(Suppl 4):S134-44.
17. Day K, Boarnet M, Alfonzo M, Forsyth A. The Irvine-Minnesota Inventory to measure built environments: Development. *Am J Prev Med* 2006;30(2):144-52.
18. Nykiforuk CIJ, Schopflocher D, Vallianatos H, Spence JC, Raine KD, Plotnikoff RC, et al. Community Health and the Built Environment: Examining place in a Canadian chronic disease prevention project. *Health Promot Int* 2012; first published online January 6, 2012 doi:10.1093/heapro/dar093.
19. Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: Assessing partnership approaches to improve public health. *Annu Rev Public Health* 1998;19:173-202.
20. Moffatt L. Chronic Disease Prevention Alliance of Canada. Knowledge Exchange in Health Promotion: Theoretical Models and Examples. Ottawa, ON: Chronic Disease Prevention Alliance of Canada, 2007. Available at: http://www.cdpac.ca/media.php?mid=274 (Accessed December 21, 2011).
21. Town of Bonnyville. Bonnyville in Profile. Available at: http://www.town.bonnyville.ab.ca/index.php/living-in-bonnyville/about-bonnyville/bonnyville-in-profile (Accessed December 21, 2011).
22. Rosenberg S, Kim MK. The method of sorting as a data-gathering procedure in multivariate research. *Multivariate Behav Res* 1975;10(4):489-502.
23. Ward JH. Hierarchical grouping to optimize an objective function. *J Am Stat Assoc* 1963;580:236-44.
24. Izenman AJ. *Modern Multivariate Statistical Techniques: Regression, Classification, and Manifold Learning*. New York: Springer, 2008.
25. ter Braak CJF. Interpreting canonical correlation analysis through biplots of structure correlations and weights. *Psychometrika* 1990;55(3):519-31.
26. Boone-Heinonen J, Popkin BM, Song Y, Gordon-Larsen P. What neighborhood area captures built environment features related to adolescent physical activity? *Health Place* 2010;16(6):1280-86.
27. Oliver L, Schuurman N, Hall A, Hayes M. Assessing the influence of the built environment on physical activity for utility and recreation in suburban Metro Vancouver. *BMC Public Health* 2011;11(1):959.
28. Hoehner CM, Handy SL, Yan Y, Blair SN, Berrigan D. Association between neighborhood walkability, cardiorespiratory fitness and body-mass index. *Soc Sci Med* 2011;73(12):1707-16.
29. Keegan TH, Hurley S, Goldberg D, Nelson DO, Reynolds P, Bernstein L, et al. The association between neighborhood characteristics and body size and physical activity in the California Teachers Study cohort. *Am J Public Health* [published online ahead of print August 18, 2011].
30. McCreedy M, Leslie JG. Get Active Orlando: Changing the built environment to increase physical activity. *Am J Prev Med* 2009;37(6 Suppl 2):S395-402.

RÉSUMÉ

Objectifs : Les évaluations approfondies du milieu bâti résistent souvent aux tentatives de réduction et de synthèse des données. Nous avons cherché à élaborer une méthode de réduction des données sur le milieu bâti qui permette de communiquer efficacement ces données aux chercheurs et aux acteurs locaux. Notre objectif est de faire comprendre comment on peut utiliser ces données pour créer des regroupements de quartiers fondés sur les caractéristiques du milieu bâti, et que le processus de discussion des quartiers avec les acteurs locaux peut entraîner la mise au point d'interventions de promotion de la santé renforcées par un apport communautaire.

Méthode : À l'aide de la liste de critères Irvine-Minnesota Inventory (IMI), nous avons évalué 296 segments d'une communauté semi-rurale de l'Alberta. Des évaluateurs experts ont « créé » des quartiers en examinant les données. Ensuite, nous avons élaboré un regroupement consensuel au moyen d'une analyse en grappes, et réduit le nombre de variables IMI caractérisant les quartiers au moyen d'une analyse discriminante multiple.

Résultats : Les 296 segments ont été réduits par consensus à un ensemble de 10 quartiers, lesquels se distinguent les uns des autres selon 9 fonctions construites à partir de 24 variables IMI. Des biplots de ces fonctions ont été un moyen efficace de résumer et de présenter les résultats de l'évaluation communautaire, et ont stimulé l'action communautaire.

Conclusions : Il est possible d'utiliser des méthodes quantitatives raisonnées pour réduire de grandes quantités d'information sur le milieu bâti en résumés signifiants. Ces résumés, ou « quartiers selon le milieu bâti », ont été utiles pour catalyser des actions avec les acteurs locaux et ont mené à l'élaboration d'interventions sur le milieu bâti favorisant la santé.

Mots clés : milieu bâti; méthodes quantitatives; promotion de la santé; échange des connaissances; réduction de l'obésité