

Walkability Index

(Please See Walkability Index report: **Development and Validation of an Urban Walkability Index for Toronto, Canada** for further details on data sources, methods of index creation and validation:

http://www.torontohealthprofiles.ca/a_documents/aboutTheData/12_1_ReportsAndPapers_Walkability_WKB_2012.pdf)

Introduction

Research suggests that urban environments that discourage walking and other physical activities have contributed to the current epidemic of overweight and obesity. Various ‘walkability’ indices have been created combining characteristics of neighbourhood built environments that encourage or discourage walking. Due to issues of data quality and availability in Toronto, we were unable to exactly replicate some of the most commonly used indices. Therefore, the purpose of this work was to create a walkability index for Toronto, Canada, building on work that has already been published in this area and subsequently to validate and test its performance at different levels of census geography.

Methods

Selection and creation of candidate variables

A list of candidate variables was generated from a thorough literature review to identify variables that had been shown to be relevant to neighbourhood walkability, transportation choices, walking, physical activity levels, or body weight.

To create the candidate variables we constructed a walking network using network analysis tools in ArcGIS 9.3. A geometric centre point (centroid) was identified for each of the census tracts in Toronto. Geographic buffers of 720 metres around tract centroids, and other network analysis procedures, were used to create the candidate variables.

In order to investigate whether measuring and defining local environment characteristics at an even finer level of geography changes the association between a walkability index and validation outcomes, we repeated the generation of candidate variables and subsequent analyses for two smaller Statistics Canada census units, the dissemination area (DA), and the dissemination block (DB).

Density variables

Density variables for a given census tract were calculated as the average density across all tracts intersecting a 720 metre *Euclidean* (straight-line) buffer of the tract centroid.

Availability variables

Availability variables were calculated as the count of locations of a given resource type within a 720 metre network buffer of the tract centroid, based on walkable streets and paths.

Access variables

Access variables were calculated as the shortest travel time along the walking network from the tract centroid to the nearest location of a given resource (e.g., park).

Creation of a Walkability Index

Given the large number of variables that have been identified in the literature to be associated with neighbourhood 'walkability', we used a combination of factor analysis and principal component analysis to identify components of the built environment that were both statistically associated with each other and had face validity as a measure of 'walkability', as well as to produce standardized scores for each component. Index quintiles were generated by ordering tracts according to increasing walkability and allocating an equal number to each quintile.

The final composite index determined from the factor analysis was composed of four variables: population density, residential dwelling density, availability of retail and service locations within a 10 minute walk, and street connectivity. Correlations between the walkability index and its component measures ranged from 0.70 to 0.94 (all $p \leq 0.001$). Almost identical factor loadings and correlations were found when we examined the same candidate variables using the same methodology for smaller standard census units, the DA and DB. Eigenvalues (2.8) and standardized chronbach's alpha (0.85) were identical for all three levels examined.

Data Sources

All retail and services data included in the final index was derived from Dunn & Bradstreet, Inc. (2008). Street connectivity was obtained from DMTI Spatial Inc. (2006). Population and dwelling density information was derived from the 2006 Census (Statistics Canada, 2006).

Index Validation

The walkability index was validated against actual levels of self-reported walking, physical activity and body weight from the 2006 Census of Canada, the 2006 Transportation Tomorrow Survey (TTS), and the Canadian Community Health Survey (CCHS).

Increasing levels of walkability were associated in a dose-response pattern with lower levels of car ownership, driving trips, and driving to work, as well as higher levels of walking/bicycling and use of public transit. Lower walkability was associated with higher BMI and rates of obesity. All associations were statistically significant ($p \leq 0.01$). The inverse correlation with BMI remained statistically significant even after controlling for age, sex and socio-economic status (SES) ($p < 0.01$).