



2016 User Guide

August 2021

Publication Information

The 2016 update to the Canadian Marginalization Index was created by researchers at [MAP Centre for Urban Health Solutions](#) at St. Michael's Hospital (Unity Health Toronto) and McMaster University.

How to cite this document:

Matheson, FI, Smith K LW, Moloney G, Dunn, JR. 2016 Canadian marginalization index: user guide. Toronto, ON: St. Michael's Hospital (Unity Health Toronto), 2021.

Authors

Dr. Flora I. Matheson, PhD

Research Scientist, MAP Centre for Urban Health Solutions, St. Michael's Hospital
Associate Professor, Dalla Lana School of Public Health and Centre for Criminology & Sociolegal Studies, University of Toronto

Katherine L. W. Smith, MHSc.

Research Coordinator/Statistical Analyst, MAP Centre for Urban Health Solutions, St. Michael's Hospital, McMaster University

Gary Moloney, MSA

Research Coordinator (GIS) /Spatial Analyst, MAP Centre for Urban Health Solutions, St. Michael's Hospital

Dr. James R. Dunn, PhD

Research Scientist, MAP Centre for Urban Health Solutions, St. Michael's Hospital
Professor, Department of Health, Aging and Society, McMaster University

Acknowledgements

The authors wish to thank our colleagues at MAP Centre for Urban Health Solutions for their contributions. A special thank you to Trevor van Ingen at Public Health Ontario for sharing his imputation methods, and to Rahim Moineddin at the Department of Family and Community Medicine at the University of Toronto for his guidance on the principal component analysis.

Data Sources

2016 Census of Population profiles from Statistics Canada were used to create the 2016 Index.¹⁻⁶ The data was extracted by staff at MAP Centre for Urban Health Solutions.

Future Editions

The 2016 Canadian Marginalization Index will be the last edition of the index.

Contact

For more information, please contact the Ontario Community Health Profiles Partnership (OCHPP) at HealthProfiles@smh.ca

Table of Contents

Purpose	1
Background	1
Uses of CAN-Marg.....	2
Previous Versions of CAN-Marg.....	2
Technical Details	2
Original Methods	2
2016 Update	3
Imputation	3
Limitations	4
Using CAN-Marg for Analysis	4
I. Exploring the relationship between health and social outcomes and area-level marginalization.....	4
II. Using CAN-Marg as an individual-level proxy	5
III. Mapping the Index.....	5
IV. Comparing the marginalization of two or more groups.....	5
V. Comparing rates of events.....	6
Dimensions.....	6
Households and dwellings	6
Material resources	6
Age and labour force.....	7
Immigration and visible minority.....	7
How to Use the Dimensions.....	9
Summary Score for the CAN-Marg Dimensions.....	10
Calculating an Average CAN-Marg Score Value for Higher-Order Geographical Units	10
References	12
Appendix 1: Census variables considered for inclusion.....	15
Disclaimers.....	16
About the Author Organizations.....	16

Purpose

The purpose of this document is to describe the Canadian Marginalization Index (CAN-Marg), how it was created and how it can be used to study marginalization in Canada.

Background

CAN-Marg is an area-based index that seeks to:

- show differences in marginalization between areas, and
- understand inequalities in various measures of health and social well-being, either between population groups or between geographical areas

The Index was developed using a theoretical framework based on previous work on deprivation and marginalization.^{7,8} It was then empirically derived using principal components factor analysis. It has been demonstrated to be stable across time periods and across different geographic areas (e.g., cities and rural areas).⁸ CAN-Marg is associated with health outcomes, including hypertension, chronic disease, depression, anxiety, self-rated health/stress, body mass index, smoking, binge drinking, physical inactivity, disability, activity limitation, flu shot immunization, community sense of belonging and low infant birthweight as published in a series of peer-reviewed journal articles.⁷⁻¹⁴ These papers highlight inequities in health in the Canadian setting.

CAN-Marg is multifaceted, allowing researchers and policy and program analysts to explore multiple dimensions of marginalization in urban and rural Canada. The 2016 edition of CAN-Marg uses the same dimensions as the 2001 and 2006 versions, with updated names:

- **Households and dwellings** for residential instability,
- **Material resources** for material deprivation,
- **Age and labour force** for dependency, and
- **Immigration and visible minority** for ethnic concentration.

Previous versions used names that emphasized the deficits marginalized groups and communities face (i.e., 'deprivation') and although this was consistent with theoretical approaches of the mid-20th century, we changed the names to reflect more neutral language (e.g., material deprivation becomes material resources). This change reflects the fact that the material condition of a geographic area, such as a neighbourhood, is not a trait of that area, but rather a reflection of structural inequality in material resources, as an example. The underlying principles we have adopted in the new names are to stay as close as possible to the census measures that comprise each factor, avoid deficit language, and avoid terminology that could lead to pejorative characterizations of geographic areas.

The authors recommend community consultation in conjunction with the use of this tool. While CAN-Marg is a quantitative tool which provides a description of marginalization, it is important to frame and interpret findings of marginalization for the populations under study through meaningful community

engagement. Such engagement ensures that the community helps shape the research purpose, questions, approach, interpretation and recommendations and can reduce the potential for harm from misinterpretation of findings.¹⁵ As an example, the Engagement, Governance, Access, and Protection (EGAP) Framework provides a guide to the collection, analysis and use of race-based data in ways that advance health equity.¹⁶

Uses of CAN-Marg

Planning and needs assessment: For example, CAN-Marg can be used to identify where rates of hospitalizations for a particular disease, such as diabetes, are high and additional services might be needed.

Resource allocation: For example, marginalization indices can be used in funding formulae for primary health care services.

Monitoring of inequities: For example, marginalization indices can provide a way to monitor changes in area marginalization over time to look for improvement or to identify areas that may be in decline.

Research: For example, in the health sector there is a long history of using small area indices to describe the relationship between marginalization and health outcomes; greater marginalization is associated with higher mortality rates and higher rates of many diseases.^{17–21}

Previous Versions of CAN-Marg

The 2001 and 2006 versions of CAN-Marg were calculated using data from both the short- and long-form census. In 2011, the federal government replaced the mandatory long-form census with a voluntary National Household Survey (NHS). The voluntary nature of the NHS introduced the possibility that indicators using this data would be subject to non-response bias if sampled individuals who chose to respond were different from sampled individuals who chose not to respond. As it was not possible to amass new data sources across the country, there was no update to CAN-Marg with 2011 census data. Statistics Canada replicated CAN-Marg for 1991 and 1996 using the original methods through a custom data product request.²²

Technical Details

Original Methods

Following a literature review, 42 variables were selected from the 2001 Canadian Census of Population for potential inclusion in the Index (Appendix I). Principal component factor analysis yielded four factors with Eigenvalues greater than one.^{23,24} Of the original 42 variables, 18 were included in the four factors/dimensions (Table 1). The 2001 Index was created from two core files with 49,153 dissemination areas (DAs) and 4,757 census tracts (CTs) after exclusions for coverage or lack of data availability. The Index was replicated using 2006 census data with 52,973 DAs and 5,017 CTs.

A census tract (CT) is a small, relatively stable geographic unit with a population of less than 10,000 people constructed similarly with respect to economic status and social conditions. Census tracts are located in census metropolitan areas and in census agglomerations having an urban core population of 50,000 or more as of the most recent census.²⁶

A dissemination area (DA) is a small, relatively stable geographic unit composed of one or more adjacent dissemination blocks with an average population of 400 to 700 persons. It is the smallest standard geographic area for which all census data are disseminated. DAs cover all the territory of Canada.²⁶

Factor loadings were used to compute a separate index for each of the four factors/dimensions. Factor scores and quintiles (based on the scores) for each dimension are available for every CT and DA in Canada, except where data were suppressed.²⁵ Each dimension is an asymmetrically standardized scale with a range of scores (e.g., from high material resources to low material resources). CAN-Marg applies to areas, not individual people.

2016 Update

After the re-instatement of the long-form census in 2016, the 2016 version of CAN-Marg was generated based on the original 18 indicators (where available – see Dimensions section) and methodology. The 2016 CAN-Marg was derived from 2016 census data for 54,933 DAs and 5,669 CTs after exclusions for coverage or lack of data availability (see below).²⁶ The official counts of DAs and CTs are 56,590 and 5,721 respectively.

For the 2001 and 2006 indices, “prevalence of low income using the low-income cut-off (LICO)” was one of the 18 variables included in the analysis, and this indicator loaded on the material deprivation dimension (now material resources). However, when the analysis was re-run with 2016 data, this variable no longer clearly loaded on material resources, but instead on three dimensions: households and dwellings, material resources and immigration and visible minority. When a variable loads on more than one factor/dimension, it is recommended to drop it from the analysis because the factors are no longer distinct and separate concepts.²⁷ To remain consistent with previous versions and the theoretical underpinnings of the Index, a different income variable was selected for use: average after-tax income population aged 15+. This variable loaded on material resources, and on no other dimensions.

Imputation

Imputation was done at the level of individual indicators (e.g., income) to lessen the impact of missing data on the Index. For DAs where data were suppressed for confidentiality, or omitted for data quality, or for data availability by Statistics Canada, indicator data from higher level census geographies were used in their place. Data from CTs were used in place of suppressed DA-level indicator data, where available. If CT-level data were not available, data from either the corresponding census subdivision or aggregate dissemination area were used, selected from whichever geography reported the smallest population. For CTs that experienced suppression, the same imputation methods were used: data from either the corresponding census subdivision or aggregate dissemination area were used, depending on which geography had the smallest population.

Overall, 2,708/54,933 (4.9%) of DAs and 784/5,669 (13.8%) of CTs had at least one of the 18 variables imputed. Income was the most prevalent indicator that was imputed because it has a higher threshold of release; most census variables are released if the population count for the area is 40 or more; for income, the minimum population count is 250.

Limitations

Missing data: While imputation was used to address missing data in the DA and CT files (e.g., income), some missing data remains because data were not available at any geographic scale. Additionally, in some areas, input variables have a value of zero. For example, a DA may not have any recent immigrants.

To be included in the principal component analysis, values for all 18 of the input variables were required. If a value on one or more indicators was missing, an area does not have factor scores or quintiles. Overall, 0.6% or 350 of DAs had one or more missing variables and were dropped from the DA analysis. For CTs, 0.5% or 26 CTs were dropped from the analysis.

Time period of data: Data for the Index is from the 2001, 2006, and 2016 census years and users should be aware of this when selecting the most appropriate year for their own analyses. For example, if your outcome data were collected in 2015 or 2017, you would use the 2016 Index, to ensure data comparability.

Coverage of census: Some populations, for example Indigenous people living on reserves, may be under-counted in the census.²⁵ For the 2016 index, people living on reserves were excluded. Additionally, institutionalized populations, such as those living in nursing homes or penitentiaries, are not counted in the long-form census and so their responses to the census are not included in the Index.²⁸ Refer to Statistics Canada to see if census coverage will impact your analyses.²⁹

Using CAN-Marg for Analysis

I. Exploring the relationship between health and social outcomes and area-level marginalization

Outcomes can include the following:

- individual health status,
- social-behavioural indicators,
- individual risk or protective factors, and/or
- rates of disease, or any health-related event.

Research questions that could be answered include:

- 1) What is the association between health outcomes, such as mortality and diabetes rates, and area-level marginalization?
- 2) What is the association between health behaviours, such as smoking and alcohol consumption, and area-level marginalization?

- 3) What is the association between access to routine surgical procedures, such as joint replacement, and area-level marginalization?
- 4) What is the association between health service utilization, such as mental health visits, and marginalization?

To answer such questions, merge the outcome file with CAN-Marg, following the steps below:

- 1) Prepare the outcome file:
 - a. Ensure address and/or postal code file(s) are error-free.
 - b. Geocode each observation in your outcome data set (e.g., mortality, crime events, hypertension) to CT or DA. Often, where only anonymized postal code data are available, this is accomplished using the PCCF+ SAS program created by Statistics Canada.³⁰ Now every record is associated with a particular CT or DA (or other census geography).
- 2) Merge your health outcome data set with the CAN-Marg CT or DA file (or other census geography if you have aggregated up), thus linking each geocoded outcome with the appropriate area marginalization scores.

II. Using CAN-Marg as an individual-level proxy

In some instances, CAN-Marg can be used as a proxy for individual-level data when actual data is not available. If individual-level socio-economic status data is unavailable, for example, DA-level factor scores or quintiles for material resources can be assigned to each individual based on the DA in which the individual resides and used as a proxy for socioeconomic status.

To minimize measurement error, use the smallest spatial area available. In the case of CAN-Marg, this is DA data. The reason is similar to that provided under the “caution” for weighted averages on page 11. As the size of the geographic unit increases (e.g., CTs, CSDs), the potential for ecological fallacy increases as well, since not everyone in a marginalized area is marginalized.

In effect, using areas larger than the DA will weaken the association between individual- and area-level marginalization. The larger the geographic area, the less likely it is that an individual’s socio-economic status will correspond to the material resources score of the area in which they live.

III. Mapping the Index

The Index can be displayed geographically using mapping software such as ArcGIS or MapInfo.

IV. Comparing the marginalization of two or more groups

If you want to compare levels of marginalization between two or more groups (e.g., hypertensive versus non-hypertensive; diabetic versus non-diabetic) you can compare the distributions of quintiles (or factor scores) using a non-parametric test. This test is used because quintile values are ordinal, and the principal component scores are skewed.

V. Comparing rates of events

If you are comparing rates of events with marginalization (e.g., mortality rates in a region compared across the five marginalization scale values), you can calculate a rank correlation coefficient or simply plot your results. Note that the denominators for your rates can be obtained from the CT or DA populations.

Dimensions

The original factor analysis of 42 indicators from the 2001 Canadian census (Appendix 1) selected 18 indicators grouped across four dimensions of marginalization (Table 1). These four dimensions have remained consistent for the 2001, 2006 and 2016 versions of CAN-Marg; however, there are differences over time. The following sections shows the indicators that are included in each dimension, and any differences over time.

Households and dwellings

Households and dwellings refers to dwelling or housing security. The indicators included in this dimension measure the types and density of residential accommodations, as well as certain family structure characteristics. This measure is related to neighborhood quality, cohesiveness and supports.³¹

INDICATORS
Proportion of the population living alone
Proportion of the population who are not youth (age 5-15)*
Average number of persons per dwelling*, **
Proportion of dwellings that are apartments in a building with 5 or more stories
Proportion of the population who are single/divorced/widowed*
Proportion of dwellings that are not owned
Proportion of the population who moved during the past 5 years

* Indicators were reverse coded, meaning they were coded opposite of the measure (e.g., % married/common law becomes %single/divorced/separated/widowed).

**In 2016, the Statistics Canada 'Average household size' variable was used, which measures the same concept as 'Average number of persons per dwelling'.

Material resources

Material resources refers to individual and community access to and attainment of basic material needs. The indicators included in this dimension measure income, unemployment, quality of housing, educational attainment and family structure characteristics.³² The definitions for the education and income indicators have changed in the different versions of the Index. Differences are noted in the table at the top of the next page.

Material resources

INDICATORS	
2016	2001/2006
Proportion of the population aged 15+ without a high-school diploma*	2001: Proportion of the population aged 20+ without a high-school diploma 2006: Proportion of the population aged 25+ without a high-school diploma
Proportion of families who are lone parent families	
Proportion of total income from government transfer payments for population aged 15+	
Proportion of the population aged 15+ who are unemployed	
Average after-tax income for population aged 15+ **	Proportion of the population considered low-income***

* This variable changed due to data availability.

** Average income was reverse coded as maximum average income for all DAs/CTs – average income. This variable was introduced for the 2016 Index. The prevalence of low-income did not load in the factor analysis and was replaced by the average income measure. See Technical details section.

*** “Low income” is defined as below the low-income cutoff (LICO), a Statistics Canada measure that is adjusted for community size, family size and inflation.

Age and labour force

Age and labour force refers to seniors, children and adults whose work is not compensated, and who do not have income from employment. Adults included under this measure may be taking care of households, taking care of people in the community and/or prevented from working due to disability.

INDICATORS
Proportion of the population who are aged 65+
Dependency ratio (total population 0-14 and 65+/ total population 15 to 64)
Proportion of the population not participating in labour force (aged 15+)

Immigration and visible minority

Immigration and visible minority refers to recent immigrants and/or people belonging to a ‘visible minority’ group (defined by Statistics Canada as “persons, other than aboriginal peoples, who are non-Caucasian in race or non-white in colour”). Statistics Canada Aboriginal status indicators did not load on any of the factors during initial factor analysis. Research on immigration in Ontario shows that newcomers to Canada often have better overall health outcomes³³, a phenomenon commonly known as the “healthy immigrant effect.” At the same time, research is clear that both structural racism and anti-immigrant discrimination have profound impacts on individual, community and population health.³⁴

INDICATORS
Proportion of the population who are recent immigrants (arrived in past 5 years)
Proportion of the population who self-identify as a visible minority

Table 1: Dimensions of marginalization and their respective census indicators

2016 DIMENSIONS				
Households and dwellings ^		Material resources ^	Age and labour force ^	Immigration and visible minority ^
INDICATORS	Proportion of the population living alone	Proportion of the population aged 15+ without a high-school diploma ***	Proportion of the population who are aged 65+	Proportion of the population who are recent immigrants (past 5 years)
	Proportion of the population who are not youth (age 5-15)*	Proportion of families who are lone parent families	Dependency ratio (total population 0-14 and 65+/ total population 15 to 64)	Proportion of the population who self-identify as a visible minority
	Average number of persons per dwelling*, **	Proportion of total income from government transfer payments for population aged 15+	Proportion of the population not participating in labour force (aged 15+)	
	Proportion of dwellings that are apartments in a building with 5+ stories	Proportion of the population aged 15+ who are unemployed		
	Proportion of the population who are single/divorced/widowed*	Average after-tax income for population aged 15+ *, ****		
	Proportion of dwellings that are not owned	Proportion of households living in dwellings that are in need of major repair		
	Proportion of the population who moved during the past 5 years			

^ Dimension names were changed in 2016 (see Background section). Households and dwellings=Residential instability. Material resources=Material deprivation. Age and labour force=Dependency. Immigration and visible minority=Ethnic concentration.

* Indicators were reverse coded, meaning they were coded opposite of the measure (e.g., % married/common law becomes %single/divorced/separated/widowed). Average income was reverse coded as maximum average income for all DAs/CTs – average income.

**In 2016, the Statistics Canada ‘Average household size’ variable was used, which measures the same concept as ‘Average number of persons per dwelling’.

*** The original 2001 Index used “proportion of the population aged 20+ without a certificate, diploma or degree”. The variable available for 2006 was “proportion of the population aged 25+ without a certificate, diploma or degree”, and for 2016, it was 15+.

****This variable was introduced for the 2016 Index. The prevalence of low-income did not load in the factor analysis and was replaced by another income measure. See Technical details section.

How to Use the Dimensions

The CAN-Marg dimensions can be used separately or combined into a composite index (see next section). Whether you use individual dimensions, or the combined index will be determined by the research question. For each dimension, CAN-Marg is provided in two forms:

- Factor scores (interval scale):** Factor scores are constructed from the principal component factor analysis. Each CAN-Marg dimension represents a standardized scale with a mean of zero and a standard deviation of one. Lower scores on each dimension correspond to areas that are the least marginalized; higher scores on each dimension correspond to areas that are the most marginalized. Please refer to Table 2 for interpretation of the factor scores for each dimension.
- Quintiles (ordinal scale):** Quintiles have been created by sorting the marginalization data into five groups, ranked from one (least marginalized) to five (most marginalized). See Table 2 for the interpretation of the quintiles. Each group contains a fifth of the geographic units (e.g., DAs). For example, if an area has a value of five on the material resources scale, it means it is in the 20 percent of areas in Canada with the least material resources. The quintiles were created country-wide to enable comparability; however, if you are interested in a particular province, city or urban area, the quintiles may be re-created using the individual factor scores for the geography of interest. Note that the scores will not be standardized for new geographies. For example, the Alberta factor data could be copied into a new dataset and sorted from highest to lowest. This data would then be divided into five equal groups, with the group with the highest scores being assigned a quintile of 5, etc. Now the quintiles are comparable within Alberta only.

Table 2: Interpretation of factor scores and quintiles for each dimension

	FACTOR SCORES	QUINTILES
Households and dwellings	Higher values mean <u>less</u> security*	1=most household/dwelling security 5=least household/dwelling security
Material resources	Higher values mean <u>less</u> material resources*	1=most material resources 5=least material resources
Age and labour force	Higher values mean higher proportions of seniors, children, and those not in the labour force	1=lowest proportions of seniors, children, and those not in the labour force 5=highest proportions of seniors, children, and those not in the labour force
Immigration and visible minority	Higher values mean higher proportions of recent immigrants and visible minorities	1=lowest proportions of recent immigrants and visible minorities 5=highest proportions of recent immigrants and visible minorities

* Please note that with the renaming of the Households and dwellings (previously Residential Instability), and Material resources (previously Material deprivation) dimensions, the direction of the interpretation has changed. For example, higher values on these dimensions used to be associated with more deprivation and more instability, but now higher values are associated with less resources and less security.

The objectives of your analysis and the methods you are using will determine whether you use factor scores or quintiles in your analysis. For example, a mapping exercise might be best presented using quintiles, whereas a regression model might benefit from the detail of the factor scores.

Summary Score for the CAN-Marg Dimensions

Users may wish to examine overall marginalization using a summated score. This can be done using the quintile scales for each dimension. Follow these steps to calculate the summated score:

- 1) **Compare the correlations between each dimension with the outcome.** This allows you to determine if the associations are in the same direction. If the associations are either all positively or all negatively associated with the outcome, then an average marginalization score can be computed. ***If one or more dimensions are in the opposite direction, it is not recommended to combine the dimensions.*** For example, if immigration and visible minority is negatively associated with the outcome of interest, this may represent a protective factor (e.g., a healthy immigrant effect) and it may not be appropriate to combine immigration and visible minority with the other dimensions that are positively associated with the outcome and therefore represent risk factors.
- 2) Sum the quintile values across the four dimensions.
- 3) Divide by 4 (which is the number of dimensions).

$$\text{Summary Score} = (\text{households_dwellings_q_DA16} + \text{material_resources_q_DA16} + \text{age_labourforce_q_DA16} + \text{immigration_vismin_q_DA16}) / 4$$

These steps will produce a score ranging from one to five, where one reflects low levels of marginalization and five reflects high levels of marginalization.

Caution: Factor scores cannot be used to obtain a summary score.

Calculating an Average CAN-Marg Score Value for Higher-Order Geographical Units

Some research and policy questions require geo-coding at custom geographic units. You can use the DA and CT data in CAN-Marg and the methods described in this section to create values for your own geographies, using population-weighted average scores.

Example: Calculating weighted average scores for alternative geographic areas from 2016 CT- or DA-level marginalization scores.

- 1) Define the areas in terms of the component CTs and/or DAs.
- 2) Using the population counts, take the weighted average of each factor score value across all the CTs or DAs in the health region. To obtain the weighted average for the health region, follow these steps:

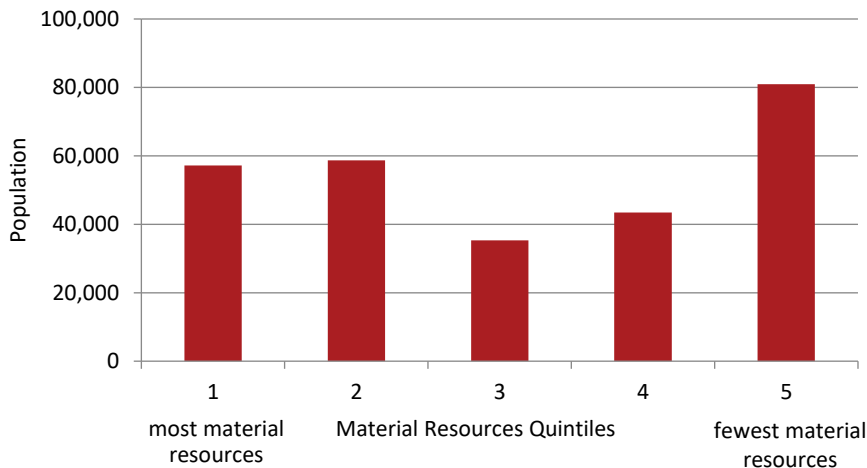
- a. Multiply each CT or DA marginalization score value by the population within the CT or DA for the health region.
 - b. Sum the multiplied values from a). This becomes the numerator.
 - c. Sum the population values from each CT or DA to obtain a total population count for the health region. This becomes the denominator.
 - d. Divide the total from b) by the total from c). This is your weighted average.
- 3) You can now use these weighted averages to create quintiles.

Weighted average material resources score:

$$\frac{\sum(\text{material_resources_CT16} * \text{CTPop_2016})}{\sum(\text{CTPop_2016})}$$

Caution: Weighted averages can disguise heterogeneity within large geographic areas. For example, when the weighted average method is used to determine the material resources quintile for the East Toronto Sub-Region, the result is five (fewest material resources). Figure 1, however, shows the true variation in this Sub-Region by using summed DA population counts by quintile, not weighted averages, to show the number of people in each quintile. The resulting graph shows there are pockets of low, moderate and high material resources that would be masked by using the summary score of five.

Figure 1. Population in each quintile in East Toronto Sub-Region, based on DA population



References

1. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016005 [Internet]. Ottawa: Statistics Canada. [cited 2017 May 3]. Available from: <https://www12.statcan.gc.ca/datasets/Index-eng.cfm?Temporal=2016>
2. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016003 [Internet]. Ottawa: Statistics Canada. [cited 2017 May 3]. Available from: <https://www12.statcan.gc.ca/datasets/Index-eng.cfm?Temporal=2016>
3. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-401-X2016050 [Internet]. Ottawa: Statistics Canada. [cited 2017 Sep 13]. Available from: <https://www150.statcan.gc.ca/n1/en/catalogue/98-401-X2016050>
4. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-401-X2016055 [Internet]. Ottawa: Statistics Canada. [cited 2017 Aug 31]. Available from: <https://www150.statcan.gc.ca/n1/en/catalogue/98-401-X2016055>
5. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-401-X2016043 [Internet]. Ottawa: Statistics Canada. [cited 2020 Nov 24]. Available from: <https://www150.statcan.gc.ca/n1/en/catalogue/98-401-X2016043>
6. Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-401-X2016044 [Internet]. Ottawa: Statistics Canada. [cited 2018 Oct 19]. Available from: <https://www150.statcan.gc.ca/n1/en/catalogue/98-401-X2016044>
7. Matheson FI, Moineddin R, Dunn JR, Creatore MI, Gozdyra P, Glazier RH. Urban neighborhoods, chronic stress, gender and depression. *Soc Sci Med*. 2006 Nov;63(10):2604–16.
8. Matheson FI, Dunn JR, Smith KLW, Moineddin R, Glazier RH. Development of the Canadian Marginalization index: A new tool for the study of inequality. *Can J Public Heal*. 2012;103(SUPPL.2).
9. Matheson FI, White HL, Moineddin R, Dunn JR, Glazier RH. Neighbourhood chronic stress and gender inequalities in hypertension among Canadian adults: A multilevel analysis. *J Epidemiol Community Health*. 2010 Aug;64(8):705–13.
10. Matheson FI, Moineddin R, Glazier RH. The weight of place: A multilevel analysis of gender, neighborhood material deprivation, and body mass index among Canadian adults. *Soc Sci Med* [Internet]. 2008 Feb [cited 2021 Apr 26];66(3):675–90. Available from: <https://pubmed.ncbi.nlm.nih.gov/18036712/>
11. Matheson FI, White HL, Moineddin R, Dunn JR, Glazier RH. Drinking in context: The influence of gender and neighbourhood deprivation on alcohol consumption. *J Epidemiol Community Health*. 2012;66(6).
12. Urquia ML, Frank JW, Glazier RH, Moineddin R, Matheson FI, Gagnon AJ. Neighborhood context and infant birthweight among recent immigrant mothers: A multilevel analysis. *Am J Public Health* [Internet]. 2009 Feb 1 [cited 2021 Apr 26];99(2):285–93. Available from: <https://pubmed.ncbi.nlm.nih.gov/19059866/>

13. White HL, Matheson FI, Moineddin R, Dunn JR, Glazier RH. Neighbourhood deprivation and regional inequalities in self-reported health among Canadians: Are we equally at risk? *Heal Place* [Internet]. 2011 [cited 2021 Apr 27];17(1):361–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/21177136/>
14. Lee P. Injury and neighbourhood marginalization: does it matter where you live? [Internet]. University of Toronto; 2009. Available from: https://tspace.library.utoronto.ca/bitstream/1807/18811/1/Lee_Patricia_PS_200909_MSc_thesis.pdf
15. Wanigaratne S, Mawani FN, O’Campo P, Cole DC, Ibrahim S, Muntaner C. Commentary in response to “characterising the risk of homicide in a population-based cohort” (O’Neill et al, 2019) [Internet]. Vol. 74, *Journal of Epidemiology and Community Health*. BMJ Publishing Group; 2020 [cited 2021 Apr 28]. p. 977–8. Available from: <http://dx.doi.org/10.1136/jech-2019-213249>
16. Black Health Equity Working Group. Engagement, Governance, Access, and Protection (EGAP): A Data Governance Framework for Health Data Collected from Black Communities [Internet]. 2021. Available from: https://blackhealthequity.ca/wp-content/uploads/2021/03/Report_EGAP_framework.pdf
17. Eames M, Ben-Shlomo Y, Marmot MG. Social deprivation and premature mortality: Regional comparison across England. *Br Med J* [Internet]. 1993 [cited 2021 Apr 26];307(6912):1097–102. Available from: <https://pubmed.ncbi.nlm.nih.gov/8251806/>
18. Mcloone P, Boddy FA. Deprivation and mortality in Scotland, 1981 and 1991. *BMJ*. 1994 Dec 3;309(6967):1465.
19. Townsend P, Davidson N, editors. *Inequalities in health: the Black report*. Harmondsworth, UK: Penguin; 1982.
20. Townsend P, Philimore P, Beattie A. *Health and deprivation: inequality and the north*. New York, NY: Croom Helm; 1988.
21. Kitiwaga E, Hauser P. *Differential mortality in the United States: a study in socioeconomic epidemiology*. Cambridge, MA: Harvard University Press; 1973.
22. Statistics Canada. Canadian Marginalization Index (CAN-Marg) 1996 and 1991 Development [Internet]. 2018. Available from: http://www.ontariohealthprofiles.ca/onmarg/userguide_data/CANMarg_1991-1996_DevelopmentSummary.pdf
23. UCLA: Statistical Consulting Group. Principal Components Analysis | SAS Annotated Output [Internet]. Los Angeles: UCLA. [cited 2021 Aug 9]. Available from: <https://stats.idre.ucla.edu/sas/output/principal-components-analysis/>
24. Kim J, Mueller CW. *Factor Analysis: Statistical Methods and Practical Issues*. Thousand Oaks, CA: SAGE Publications, Inc.; 1978.
25. Statistics Canada. About the data, Census Profile, 2016 Census [Internet]. Ottawa: Statistics Canada. 2016 [cited 2021 Jun 21]. Available from: <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/about-apropos/about-apropos.cfm?Lang=E>

26. Statistics Canada. 2016 census dictionary [Internet]. Ottawa: Statistics Canada. 2016 [cited 2021 Apr 27]. Available from: <https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/az1-eng.cfm#C>
27. O'Rourke N, Hatcher L. A Step-by-Step Approach to Using SAS[®] for Factor Analysis and Structural Equation Modelling, Second Edition [Internet]. 2nd ed. SAS Institute; 2013. Available from: https://www.sas.com/storefront/aux/en/spsxsfactor/61314_excerpt.pdf
28. Statistics Canada. Guide to the Census of Population, 2016. Chapter 5 – Census of Population questionnaires. [Internet]. Ottawa: Statistics Canada. 2016 [cited 2021 Jun 28]. Available from: <https://www12.statcan.gc.ca/census-recensement/2016/ref/98-304/chap5-eng.cfm>
29. Statistics Canada. Coverage of the 2016 Census: Level and trends [Internet]. Ottawa: Statistics Canada. 2021 [cited 2021 Jun 28]. Available from: <https://www150.statcan.gc.ca/n1/pub/91f0015m/91f0015m2020003-eng.htm>
30. Statistics Canada. Postal Code Conversion File (PCCF+): August 2015 [Internet]. Ottawa, ON: Government of Canada; 2017. Available from: <https://www150.statcan.gc.ca/n1/en/catalogue/82F0086X>
31. Turney K, Harknett K. Neighborhood Disadvantage, Residential Stability, and Perceptions of Instrumental Support among New Mothers. *J Fam Issues* [Internet]. 2010 Apr [cited 2021 Apr 26];31(4):499–524. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22102766>
32. Tøge AG, Bell R. Material deprivation and health: A longitudinal study. *BMC Public Health* [Internet]. 2016 Aug 8 [cited 2021 Apr 26];16(1). Available from: <https://pubmed.ncbi.nlm.nih.gov/27501962/>
33. Khan AM, Urquia M, Kornas K, Henry D, Cheng SY, Bornbaum C, et al. Socioeconomic gradients in all-cause, premature and avoidable mortality among immigrants and long-term residents using linked death records in Ontario, Canada. *J Epidemiol Community Health* [Internet]. 2017 Jul 1 [cited 2021 Apr 26];71(7):625–32. Available from: <https://pubmed.ncbi.nlm.nih.gov/28289039/>
34. Nestel S. Colour coded health care: the impact of race and racism on Canadians' health [Internet]. Toronto, ON; 2012. Available from: <https://www.wellesleyinstitute.com/health/colour-coded-health-care-the-impact-of-race-and-racism-on-canadians-health/>

Appendix 1: Census variables considered for inclusion*

- Proportion of the population who moved during the past 5 years
- Proportion living in same house as 1 year ago
- Proportion of population lone parent families
- Proportion of population living alone
- Dependency ratio (total population 0-14 and 65+/ total population 15 to 64)
- Proportion of population youth (aged 5-15)
- Proportion foreign born
- Proportion Aboriginal
- Proportion of the population who are recent immigrants (arrived in the 5 years prior to census)
- Proportion with no official language
- Proportion unemployed (aged 15+)
- Labour force participation rate (aged 15+)
- Proportion who self-identify as a visible minority
- Proportion aged 15-24 not attending school
- Proportion aged 20+ without high school diploma
- Proportion of the population considered low income using the low-income cut-off (LICO)
- Average household income
- Proportion of income from government transfer payments
- Proportion with no religious affiliation
- Average dollar value of dwelling
- Proportion of dwellings that are apartments in a building with 5 or more stories
- Proportion of owner households spending 30% or more of household income on major payments
- Proportion of tenant households spending 30% or more of household income on rent
- Proportion of dwellings that are owned
- Proportion of occupied units that are rentals
- Proportion of population self-employed
- Proportion of population female
- Proportion of population married/common law
- Proportion of households living in dwellings that are in need of major repair
- Proportion of population aged 15+ doing unpaid housework
- Proportion of population aged 15+ looking after children without pay
- Proportion of population aged 15+ providing unpaid care/assistance to seniors
- Raw population count
- Average number of persons per dwelling
- Average number of persons per room
- Ratio of employment to population
- Average income
- Proportion of persons separated, divorced or widowed
- Proportion of children younger than 6 years
- Persons per square kilometer
- Unemployment rate in private households with children under 6 years
- Proportion of the population who are aged 65 and older

* This variable list represents variables available in the 2001 census. Some of these variables are not available in the 2016 census.

Disclaimers

St. Michael's Hospital

This document was developed by MAP Centre for Urban Health Solutions at St. Michael's Hospital (Unity Health Toronto) and McMaster University.

This document may be reproduced without permission for non-commercial purposes only and provided that appropriate credit is given to St. Michael's and McMaster. No changes and/or modifications may be made to this document without express written permission from the authors.

Ethics Approval

This study was approved by the St. Michael's Hospital Research Ethics Board.

About the Author Organizations

MAP Centre for Urban Health Solutions – St. Michael's Hospital

MAP Centre for Urban Health Solutions is an inter-disciplinary research centre within St. Michael's Hospital (Unity Health Toronto). The Centre seeks to improve health in cities, especially for those experiencing marginalization, and to reduce barriers to accessing factors essential to health, such as appropriate health care and quality housing. We are committed to developing and implementing concrete responses within health care and social service systems and at the level of public policy.

St. Michael's Hospital provides compassionate care to all who enter its doors. The hospital also provides outstanding medical education to future health care professionals in more than 29 academic disciplines. Critical care and trauma, heart disease, neurosurgery, diabetes, cancer care, care of the homeless, and global health are among the Hospital's recognized areas of expertise. Through the Keenan Research Centre and the Li Ka Shing International Healthcare Education Center, which make up the Li Ka Shing Knowledge Institute, research and education at St. Michael's Hospital are recognized and make an impact around the world. Founded in 1892, the hospital is fully affiliated with the University of Toronto.

For more information, visit the [MAP Centre for Urban Health Solutions](#) website.

McMaster Institute for Health Equity

The McMaster Institute for Health Equity (MIHE) takes leadership in encouraging evidence-based action on health inequities by developing research capacity and stimulating knowledge mobilization.

For more information, visit the [MIHE](#) website.

Collaboratory for Research on Urban Neighbourhoods, Community Health and Housing

The Collaboratory for Research on Urban Neighbourhoods, Community Health and Housing (CRUNCH) is a cluster of affiliated researchers, facilities and equipment, housed at McMaster University. CRUNCH is dedicated to examining the complex interactions between housing, neighbourhoods and health.

For more information, visit the [CRUNCH](#) website.