2011 Ontario Marginalization Index: Technical document

November 2017

ON-Marg
Ontario Marginalization Index
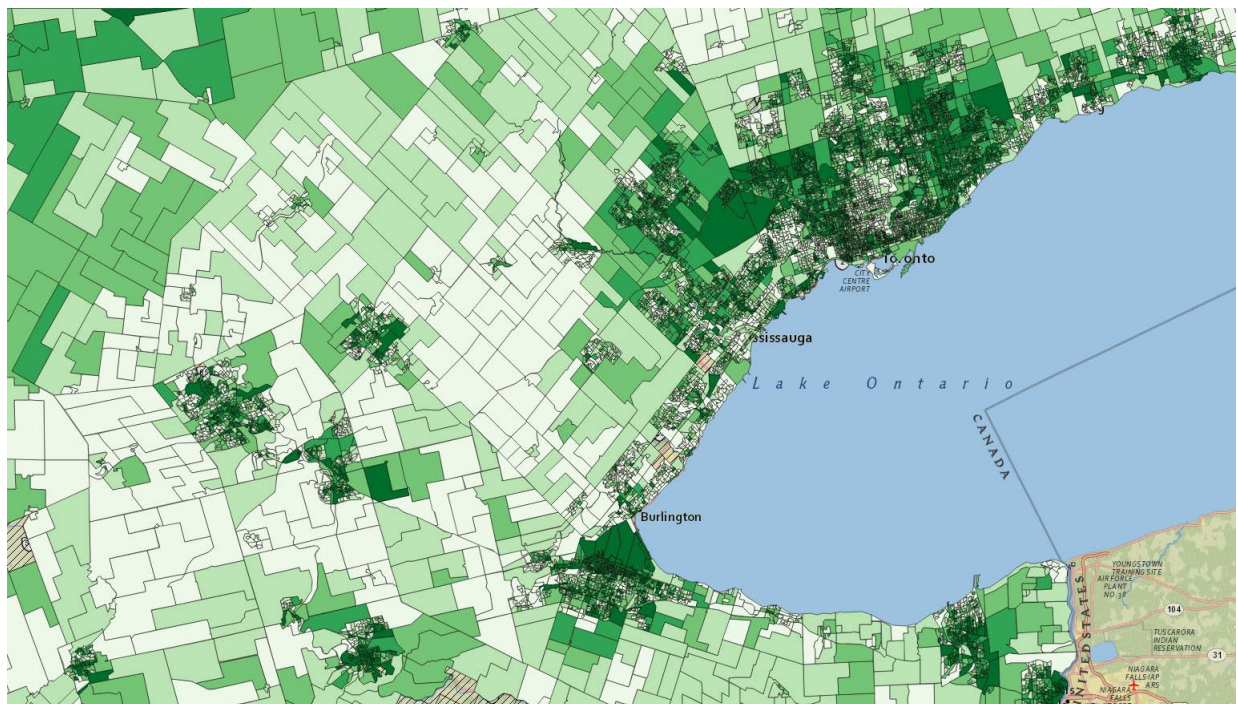
Publication information

Authors

Dr. Flora I. Matheson, PhD
Research Scientist
Centre for Urban Health Solutions
St. Michael's Hospital

Trevor van Ingen
Epidemiologist Lead, Analytic Services
Knowledge Services
Public Health Ontario

Acknowledgements

Data sources

The data sources used in the creation of the 2011 index are:

1) Immigration, Refugees and Citizenship Canada
2) Statistics Canada T1 Family File (T1FF)
3) Municipal Property Assessment Corporation (MPAC)
4) Registered Persons Database, Institute for Clinical Evaluative Sciences
5) Statistics Canada 2011 Census of Canada Census Profiles for dissemination areas

Contact

For more information about the 2011 update to the Ontario Marginalization Index, please contact HealthProfiles@smh.ca or Analytics@oahpp.ca.

Contents

Introduction

> The creation of a 2011 version of ON-Marg provides a more current assessment of the distribution of marginalization in Ontario. This tool is available for users in government, public health, and to researchers to better understand neighbourhood-level marginalization and health equity. The availability of index data from 2001, 2006 and 2011 will further strengthen its use for analysis of trends in marginalization and health equity.
>
> The purpose of this document is to describe the technical aspects of the 2011 update to ON-Marg, including the methodology and results. The alternative data sources and the indicators derived from them will be described in detail. A validation analysis was also conducted to explore the impact of using alternative data sources, and the comparability of the 2006 and 2011 versions of ON-Marg.

Health inequities are largely driven by the inequitable distribution of power, money, resources and access to those resources necessary for health. Key to understanding and addressing these health inequities is the ability to conduct population health assessments that link health outcomes with measures of marginalization. Most public health data collected and analysed in Ontario does not contain sufficient information on socio-economic status to be used for population health equity measurement. Area-based marginalization indices allow public health researchers and practitioners to study health equity by making links between neighbourhood level-marginalization and health status.

The Ontario Marginalization Index is an area-based tool that measures multiple axes of marginalization, including economic, ethno-racial, age-based, and social marginalization, at the neighbourhood level in Ontario. ON-Marg is an Ontario specific version of the Canadian Marginalization Index, which used 18 census variables to calculate a versatile index capturing multiple dimensions of marginalization (see Appendix A for dimension descriptions).[1] The 2006 version of ON-Marg has been widely used in public health for research and population health assessment, but requires updating to reflect changes in population demographics over time.

The 2006 version of ON-Marg was based on 18 census-derived indicators: 7 from the short form census and 11 from the long-form census (Table 1). In 2011, the federal government replaced the mandatory long-form census with a voluntary National Household Survey (NHS). The voluntary nature of the NHS introduces the possibility that indicators using this data would be to be subject to non-response bias if sampled individuals who choose to respond were different from sampled individuals who chose not to respond.[2] For this reason, the 2011 update to ON-Marg does not use data from the NHS, and instead uses alternative data sources to replace indicators formally based on the long-form census.

TABLE 1. VARIABLES INCLUDED IN THE 2006 ONTARIO MARGINALIZATION INDEX AND THEIR DATA SOURCE

TABLE 1A: RESIDENTIAL INSTABILITY

Indicator	Data Source
% living alone	Short Form Census
% not youth population aged 5 to 15 years	Short Form Census
Average number persons per dwelling	Short Form Census
% single/divorced/widowed	Short Form Census
% multi-unit housing	Long Form Census
% dwellings not owned	Long Form Census
% residential mobility	Long Form Census

TABLE 1B: MATERIAL DEPRIVATION

Indicator	Data Source
% lone-parent families	Short Form Census
% aged 25+ without certificate, degree, diploma	Long Form Census
% income from government transfer payments	Long Form Census
% unemployed aged 15+	Long Form Census
% below Low income cut off (LICO)	Long Form Census
% houses needing major repair	Long Form Census

TABLE 1C: DEPENDENCY

Indicator	Data Source
% seniors (65+)	Short Form Census
Dependency ratio (0-14, 65+/15-64)	Short Form Census
Labor force participation (aged 15+)	Long Form Census

TABLE 1D: ETHNIC CONCENTRATION

Indicator	Data Source
% recent immigrants (within past 5 year)	Long Form Census
% visible minority	Long Form Census

Methods

The change from the mandatory long-form census to the voluntary NHS prompted concerns about data quality of the 11 indicators based on 2006 long-form census data. In order to replace these indicators for use in a 2011 update to ON-Marg, alternative data sources were sought that could provide high quality data to calculate similar indicators. In total, four alternative data sources were identified based on routinely collected administrative data. The Statistics Canada T1 Family File (T1FF) provides information on income and employment characteristics of all Canadian residents collected from T1 income tax returns. The Municipal Property Assessment Corporation (MPAC) is an independent organization funded by Ontario municipalities which collects routine data on the characteristics of all Ontario properties, including through in-person assessments and permit applications. The Registered Persons Database (RPDB) is maintained by the Ministry of Health and Long-Term Care (MOHLTC) and contains demographic and residential address information of all residents of Ontario who are eligible for Ontario Health Insurance Program (OHIP). The Immigration, Refugee, and Citizenship Canada (IRCC) Permanent Resident Database contains administrative and demographic records on all immigrants to Canada from 1985 onwards. Detailed descriptions of these four data sources are provided in Appendix B.

ON-Marg was originally created by selecting 42 census-based indicators covering a range of social and economic factors related to marginalization, and through a series of iterative factor analyses, removing variables with low factor loadings until four factors emerged with 18 indicators remaining. These four factors, or dimensions, were given names that describe the underlying concept of marginalization captured by the collection of indicators that strongly load with each factor:

- residential instability
- material deprivation
- dependency
- ethnic concentration

The 2011 update uses the same seven short form census indicators present in the 2001 and 2006 versions, and uses alternative data sources to calculate similar indicators to the 11 indicators from the long-form census in 2001 and 2006. In total nine indicators could be calculated that provide similar measures to the long-form census indicators for a total of 16 indicators that are included in the 2011 update. The indicators, their data sources and definitions are described in Table 2.

TABLE 2: INDICATOR DEFINITIONS FOR VARIABLES INCLUDED IN THE 2011 ONTARIO MARGINALIZATION INDEX

TABLE 2A: RESIDENTIAL INSTABILITY

Indicator	2011 Data Source	Definition
% living alone	Short-Form Census	Numerator: # living alone Denominator: Total population
% not youth population aged 5-15*	Short-Form Census	Numerator: # age 5 - 15 Denominator: Total population
Average number persons per dwelling *	Short-Form Census	Calculated by statistics Canada
% single/divorced/widowed *	Short-Form Census	Numerator: # married/common-law Denominator: Total population
% multi-unit housing	MPAC	Numerator: # of residential households with MPAC multi-unit property codes. Denominator: Total # of residential households
% dwellings not owned*	MPAC	Numerator: # of residential households occupied by the owner of the property Denominator: Total # of residential households
% residential mobility	RPDB	Numerator: # of people with recorded postal code on 2011 index date of July 1st that does not match their postal code on 2006 index date Denominator: # people with a valid postal code at index date

* Reverse coded

TABLE 2B: MATERIAL DEPRIVATION

Indicator	2011 Data Source	Definition
% lone-parent families	Short Form Census	Numerator: # lone-parent families Denominator: Total # of census families
% aged 25+ without certificate, degree, diploma	None identified	Not calculated
Proportion of income from government transfer payments[†]	T1FF	Numerator: Median dollar amount from government transfer for census families Denominator: Median dollar amount from all income sources for census families
% unemployed aged 15+	None identified	Not calculated
% below Low Income Measure[‡]	T1FF	Numerator: Number of people living in census families earning less than the after-tax low income measure Denominator: Total number of people
% houses in fair or poor condition[§]	MPAC	Numerator: # residential households in fair or poor condition Denominator: Total # of residential households

[†] Previously measured as "% income derived from government transfer payments" in 2006 ON-Marg

[‡] Previously measured as "% below Low Income Cut-Off" in 2006 ON-Marg

[§] Previously measured as "% houses needing major repair" in 2006 ON-Marg

TABLE 2C: DEPENDENCY

Indicator	2011 Data Source	Definition
% seniors (65+)	Short Form Census	Numerator: # of people 65 years and older Denominator: Total population
Dependency ratio	Short Form Census	Numerator: Total population 0-14 and 65+ Denominator: Total population 15 to 64
Employment rate*	Taxfiler	Numerator: # of people receiving labour income, including wages and salaries, commissions from employment, training allowances, tips and gratuities, self-employment income, Indian Employment Income, and employment insurance benefits Denominator: Total number of people

* Previously measured as "% labour force participation" in 2006 ON-Marg; Reverse coded

TABLE 2D: ETHNIC CONCENTRATION

Indicator	2011 Data Source	Definition
% recent immigrants	IRCC	Numerator: # of people who have immigrated to Canada in the past 5 years Denominator: Total population
% visible minority immigrants*	IRCC	Numerator: #of people belonging to a visible minority who have immigrated to Canada between 1985 and 2011. Visible minority status estimated based on country of birth, mother tongue and surname. Denominator: Total population

* Previously measured as "% visible minority" in 2006 ON-Marg

As in the previous iterations of ON-Marg, a factor analysis was used to extract four factors, or dimensions, from 16 variables calculated at the dissemination Area (DA) level in Ontario. A DA is a standard census geographic area, corresponding to approximately 400 to 700 people. Oblique rotation was used, allowing the four dimensions to co-vary. Each dimension is an asymmetrically standardized scale.

Quintiles were calculated for each dimension by ranking factor scores for each DA and sorting all DAs into five equally sized groups, each containing the same number of DAs. In this way, each quintile contains approximately an equal proportion of the population of the province.

The resulting index was validated by making comparisons with the 2006 version of ON-Marg. A version of the 2006 ON-Marg was also created using indicators derived from the alternative data sources instead of long-form census data, and comparisons were made between the alternative version and the original versions to determine what impact the alternative indicators had on factor scores and quintile values for all four dimensions.

Results

Descriptive statistics

Data for all 16 indicators analysed in the 2011 update was available for 19,569 DAs. Factor scores were not calculated for the remaining 396 DAs either because indicator data was not available at the DA-level due to suppression or the DA was in a First Nations reserve.

Table 3 describes the characteristics for the census-based indicators using 2006 and 2011 data (where available), as well as indicators from alternative data sources for 2006 and 2011. Most of the nine indicators for which alternative data was used show similar descriptive characteristics between the census and alternative versions of the indicators. Two indicators, the "% houses in fair or poor condition" and "% visible minority immigrants" variables showed the largest differences between the census and alternative versions of the indicators.

TABLE 3: DESCRIPTIVE STATISTICS FOR 2006 AND 2011 DATA USED IN THE 2011 ONTARIO MARGINALIZATION INDEX

TABLE 3A: RESIDENTIAL INSTABILITY

Variable	Data Source	N	Mean	Median	SD	Min	Max
% living alone	2006 Census	18,843	9.3%	6.9%	8.7%	0.0%	89.5%
% living alone	2011 Census	19,451	10.0%	7.4%	8.9%	0.0%	88.4%
% youth 5-15 years	2006 Census	18,902	13.9%	13.8%	4.8%	0.0%	51.7%
% youth 5-15 years	2011 Census	19,453	11.1%	10.9%	4.1%	0.0%	35.3%
person per dwelling	2006 Census	18,843	2.7	2.7	0.6	1.1	7
person per dwelling	2011 Census	19,453	2.7	2.6	0.6	0.0	5.7
% multi-unit dwelling	2006 Census	18,893	18.2%	2.8%	27.9%	0.0%	100.0%*
% multi-unit dwelling	2006 MPAC	18,156	15.5%	1.1%	26.6%	0.0%	100.0%
% multi-unit dwelling	2011 MPAC	19,674	15.7%	1.1%	26.7%	0.0%	100.0%
% married	2006 Census	18,902	59.1%	60.8%	10.0%	0.0%	91.0%
% married	2011 Census	19,453	57.8%	59.6%	10.3%	0.0%	87.5%
% owned house	2006 Census	18,843	76.1%	86.3%	25.7%	0.0%	100.0%*
% owned house	2006 MPAC	18,156	74.0%	85.1%	27.5%	0.0%	100.0%
% owned house	2011 MPAC	19,674	73.8%	84.9%	27.6%	0.0%	100.0%
% residential mobility	2006 Census	18,846	37.7%	35.5%	16.6%	0.0%	100.0%
% residential mobility	2006 RPDB	19,051	38.6%	36.0%	13.6%	0.0%	100.0%
% residential mobility	2011 RPDB	19,543	35.5%	33.0%	12.2%	0.0%	100.0%

* Values have been rounded down to 100% to correct for rounding of census count data that caused some dissemination areas to show values of greater than 100%.

TABLE 3B: MATERIAL DEPRIVATION

Variable	Data Source	N	Mean	Median	SD	Min	Max
% lone parent families	2006 Census	18,843	15.5%	13.6%	10.9%	0.0%	100.0%
% lone parent families	2011 Census	19,451	16.9%	14.9%	9.4%	0.0%	100.0%
% government transfer payment	2006 Census	18,844	11.7%	10.3%	7.3%	0.0%	71.8%
Government transfer ratio	2006 T1FF	19,161	10.4%	8.4%	8.3%	0.0%	100.0%
Government transfer ratio	2011 T1FF	19,672	10.9%	8.3%	9.4%	0.3%	89.6%
% below Low Income Cut-Off	2006 Census	18,846	13.0%	9.6%	12.8%	0.0%	93.7
% below Low Income Measure	2006 T1FF	19,162	14.3%	11.5%	10.0%	0.0%	90.1%
% below Low Income Measure	2011 T1FF	19,672	14.2%	11.4%	10.1%	0.0%	86.0%
% homes needing major repair	2006 Census	18,843	6.6%	5.7%	6.8%	0.0%	100.0%
% houses in fair or poor condition	2006 MPAC	18,156	1.7%	0.0%	3.8%	0.0%	100.0%
% houses in fair or poor condition	2011 MPAC	19,674	1.6%	0.0%	3.5%	0.0%	100.0%

TABLE 3C: DEPENDENCY

Variable	Data Source	N	Mean	Median	SD	Min	Max
% seniors (65+)	2006 Census	18,902	14.1%	12.3%	9.0%	0.0%	93.0%
% seniors (65+)	2011 Census	19,453	15.3%	13.6%	9.2%	0.0%	100.0%
Dependency ratio (0-14 + 65+) / (15-64)	2006 Census	18,902	0.487	0.452	0.312	0	30.5
Dependency ratio (0-14 + 65+) / (15-64)	2011 Census	19,405	0.486	0.447	0.321	0	21
Labour force participation rate	2006 Census	18,846	66.9%	67.9%	10.8%	0.0%	100.0%
Employment rate	2006 T1FF	19,162	69.0%	70.0%	8.4%	9.8%	92.8%
Employment rate	2011 T1FF	19,672	68.2%	69.3%	8.5%	10.0%	93.8%

TABLE 3D: ETHNIC CONCENTRATION

Variable	Data Source	N	Mean	Median	SD	Min	Max
% recent immigrants	2006 Census	18,730	3.5%	0.0%	6.1%	0.0%	59.3%
% recent immigrants	2006 IRCC	19,051	3.4%	1.3%	4.8%	0.0%	54.4%
% recent immigrants	2011 IRCC	19,543	2.8%	1.3%	3.7%	0.0%	37.3%
% visible minority	2006 Census	18,798	18.2%	7.5%	23.7%	0.0%	100.0%*
% visible minority immigrants	2006 IRCC	19,051	8.1%	2.6%	11.4%	0.0%	79.2%
% visible minority immigrants	2011 IRCC	19,543	8.5%	3.1%	11.5%	0.0%	76.3%

* Values have been rounded down to 100% to correct for rounding of census count data that caused some dissemination areas to show values of greater than 100%.

Factor Analysis

Table 4 shows the factor loadings and correlations associated with each dimension of marginalization for the 2006 and 2011 versions of ON-Marg at the DA level. Correlations between indicators and their respective marginalization dimensions were fairly consistent between 2006 and 2011 for most indicators (most ≥ 0.50). The structure of the material deprivation dimension shows the largest change. Alternative data for two of the original 2006 indicators, "% aged 25+ without certificate, degree, diploma" and "% unemployed aged 15+", were not available. Of the remaining four indicators, "% lone-parent families" and "% below Low Income Measure" indicators show much higher factor loadings and correlations in 2011 than 2006, and the factor loadings and correlations for "% houses in fair or poor condition" have fallen substantially.

TABLE 4: FACTOR LOADINGS AND CORRELATIONS FOR THE FOUR DIMENSIONS OF ON-MARG

TABLE 4A: RESIDENTIAL INSTABILITY

Indicator	2006 Factor Loading	2006 Correlation	2011 Factor Loading	2011 Correlation
% living alone	97	0.91	92	0.92
% not youth population aged 5-15	69	0.69	73	0.73
Average number persons per dwelling	85	0.85	87	0.87
% single/divorced/widowed	83	0.83	76	0.76
% multi-unit housing	76	0.76	72	0.72
% dwellings not owned	76	0.78	73	0.73
% residential mobility	46	0.46	51	0.51

TABLE 4B: MATERIAL DEPRIVATION

Indicator	2006 Factor Loading	2006 Correlation	2011 Factor Loading	2011 Correlation
% lone-parent families	60	0.6	80	0.8
% aged 25+ without certificate, degree, diploma	72	0.72	NA	NA
Government transfer ratio	74	0.74	79	0.79
% unemployed aged 15+	53	0.53	NA	NA
% below Low Income Measure	75	0.75	90	0.9
% houses in fair or poor condition	54	0.54	17	0.17

TABLE 4C: DEPENDENCY

Indicator	2006 Factor Loading	2006 Correlation	2011 Factor Loading	2011 Correlation
% seniors (65+)	90	0.9	93	0.93
Dependency ratio	82	0.82	78	0.78
Employment Rate	82	0.82	63	0.63

TABLE 4D: ETHNIC CONCENTRATION

Indicator	2006 Factor Loading	2006 Correlation	2011 Factor Loading	2011 Correlation
% recent immigrants	86	0.86	91	0.91
% visible minority	86	0.85	92	0.92

Overall, the four dimensions of marginalization show similar eigenvalues and the proportion of variance explained for the 2006 and 2011 versions of ON-Marg, as shown in Table 5. As in 2006, the 2011 version of the index showed residential instability as being the dominant dimension with the highest eigenvalues of the four dimensions, followed by material deprivation, dependency and ethnicity concentration. The cumulative proportion of variation explained by all four dimensions was 70% in 2006 and 77% in 2011.

TABLE 5. EIGENVALUES AND VARIANCE EXPLAINED FOR THE FOUR DIMENSIONS OF ON-MARG

TABLE 5A: RESIDENTIAL INSTABILITY

Measure	2006	2011
Eigenvalue	6.04	5.88
Proportion of variance explained	0.34	0.37

TABLE 5B: MATERIAL DEPRIVATION

Measure	2006	2011
Eigenvalue	3.18	3.15
Proportion of variance explained	0.18	0.20

TABLE 5C: DEPENDENCY

Measure	2006	2011
Eigenvalue	1.85	1.68
Proportion of variance explained	0.10	0.11

TABLE 5D: ETHNIC CONCENTRATION

Measure	2006	2011
Eigenvalue	1.48	1.36
Proportion of variance explained	0.08	0.09

Validation

To further validate the use of alternative data sources to replace the former long-form census variables, the 2006 version of ON-Marg was recreated using a combination of 2006 short form-census data, and 2006 data from the alternative data sources used in the 2011 update. The impact of using alternative non-census derived indicators can be determined by comparing the version of ON-Mag that includes alternative indicators against the original 2006 ON-Marg. The 2006 data for indicators derived from MPAC data were geocoded to 2011 Dissemination Area boundaries. Of 18,661 DAs included in 2006 ON-Marg, 727 could not be included in the validation analysis because they were retired between 2006 and 2011. Validation was conducted using the remaining 17,934 DAs which did not change between 2006 and 2011.

Table 6 describes the absolute difference in quintile assignment for 17,934 Ontario dissemination areas where a 2006 version of the index could be calculated from the alternative indicators. The large proportion of dissemination areas that did not change, or changed very little (+/- 1), indicate that the impact of using alternative data is small. Across all four dimensions of marginalization, most (≥90%) dissemination areas were within +/- 1 quintile of their original 2006 ON-Marg quintile value when recalculated with alternative data. High correlation coefficients also indicate that the use of alternative data sources does not have a large impact on the ability for the index to consistently measure marginalization across the four dimensions in Ontario.

TABLE 6. QUINTILE DIFFERENCES AND PEARSON CORRELATION COEFFICIENTS COMPARING DIMENSIONS OF ON-MARG THAT WERE CREATED USING ALTERNATIVE INDICATORS COMPARED WITH ALL CENSUS BASED INDICATORS FOR 17,934 ONTARIO DISSEMINATION AREAS.

Absolute difference	Residential Instability	Material Deprivation	Dependency	Ethnic Concentration
0	74.19	51.15	57.32	56.28
1	24.91	39.02	36.55	36.46
2	0.78	8.61	5.49	6.37
3	0.12	1.14	0.55	0.84
4	0	0.08	0.09	0.06
+/- 1 quintile	99.1	90.17	93.87	92.74
Correlation coefficients	0.855	0.968	0.996	0.913

Conclusion

Using data from Statistics Canada T1 Family File, Municipal Property Assessment Corporation, Immigration, Refugee, and Citizenship Canada, and the Registered Persons Database, a 2011 update to the Ontario Marginalization Index was created that does not use indicators that were previously based on the long-form census. These indicators were not available from the National Household Survey. The analysis of factor scores and eigenvalues demonstrates that the index is fundamentally performing in a similar capacity over time. Comparing 2006 data for these alternative data sources with 2006 census data demonstrates that there is minimal impact in creating ON-Marg without relying on the NHS.

While the use of NHS data at the dissemination area level was ruled out due to concerns about possible non-response bias, the indicators used in this update are based on administrative data, which is less subject to bias. Differences in indicator definitions between census and alternative indicators introduce the possibility that changes in the distribution of marginalization in Ontario between 2006 and 2011 are not related to real changes in the population, but reflect possible differences in the way the index was conducted. Since these differences are not the result of unwanted biases in the data, the index itself captures essential elements of the original census-based index and is, therefore, a useful and accurate tool for measuring how marginalization is distributed in Ontario however, caution should be given to interpreting changes over time.

Appendix A: ON-Marg dimension descriptions

Residential Instability

This measure refers to area-level concentrations of people who experience high rates of family or housing instability. The indicators included in this dimension measure the types and density of residential accommodations, as well as certain family structure characteristics. Residential instability is important as it related to neighborhood quality, cohesiveness and supports.[3]

Material Deprivation

Material deprivation is closely connected to poverty and it refers to inability for individuals and communities to access and attain basic material needs. The indicators included in this dimension measure income, quality of housing, educational attainment, and family structure characteristics.[4]

Dependency

This measure refers to area-level concentrations of people who don't have income from employment. It includes seniors, children and adults whose work is not compensated. Adults included under this measure may be taking care of households, taking care of people in the community and/or unable from working due to disability.

Ethnic concentration

This measure refers to high area-level concentrations of recent immigrants and 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 outcomes[5], 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.[6]

Appendix B: Alternative Data Sources

Statistics Canada T1 Family File (T1FF)

Description

Statistics Canada T1 Family File (T1FF) data contains information on income and employment characteristics for persons of any age who have completed a T1 tax return for the year of reference or who have received Canada Child Tax Benefits, including their non-filing spouses and children. Late filers, as well as individuals who received a T4 but did not file a T1 and cannot be linked to a family unit are excluded. The 2011 T1FF data provided in this tool is taken from 2011 T1 tax returns filed in most cases in the spring of 2012. In 2011, when compared to the Canadian census, T1FF data at the DA level had a coverage rate of 98.9% at the provincial level in Ontario.[7]

Geocoding

For the custom tabulation of the 2011 T1FF data obtained by Public Health Ontario, Statistics Canada used a single-link postal code conversion file to assign taxfiler records to 2011 census DAs. Some areas are susceptible to having populations that are misattributed to a given DA. Statistics Canada uses the postal code as the basis for assigning different levels of census geography to the T1FF data, however, postal codes do not align with standard census geographic boundaries. As a result, some postal codes overlap the boundaries of two or more DAs. In these cases, the single-link postal code conversion methodology assigns the full population of the postal code to the single dissemination area containing the majority of the dwellings, and none of that postal code's population is assigned to the other overlapping DAs. In the case of the 2011 T1FF data obtained for this mapping application, approximately 14% of all Ontario DAs did not have population assigned to them for this reason.

For a small number of taxfilers, the addresses used for filing T1 tax records are associated to a P.O. box or an address for an accountant or lawyer. Areas which include P.O. boxes or commercial buildings with accountants' or lawyers' offices might have tax filers associated to that DA who do not reside there. Instances of this behaviour are assumed to be low, but might cause some DAs to not represent the true residential addresses.

Data Suppression

Data obtained from Statistics Canada has been subjected to suppression procedures to maintain confidentiality of taxfilers recorded in the T1 Family File. Records were suppressed for DAs with less than 100 taxfilers, numerators with less than 15 observations, and for DAs where dominance occurred (a handful of taxfilers who reported a dramatically different income). For those DAs where suppression was performed, estimates based on Inverse Distance Weighted (IDW) interpolation were used instead.

Interpolation

As described above, the postal code conversion methodology used to assign taxfilers to DAs for this product has resulted in 2,751 out of 19,166 (14.4%) DAs with no taxfilers assigned. These DAs occur most often in rural areas.

Inverse Distance Weighted (IDW) Interpolation using five nearest measured points (neighbours) in ArcGIS (version 10.3) was used to estimate rate values for DAs for which indicator values were missing, due to postal code conversion or suppression by Statistics Canada. Inverse distance weighting is a spatial interpolation technique which uses known values to estimate values for unknown areas. It makes the assumption that unknown values are more similar to known values that are close and less similar to known values that are further away. The use of interpolated DAs was validated by comparing 2006 T1FF data with the 2006 Canadian census data, which were found to be similar.

Municipal Property Assessment Corporation (MPAC)

Description

Municipal Property Assessment Corporation is an independent, not-for-profit corporation funded by municipalities in Ontario to assess and classify all properties in the province. The data collected by MPAC is primarily used for collection of municipal property taxes, although it is also used for other purposes including by governments for voter registration, and commercially for banking and real estate. MPAC collects data in a standardized manner across all Ontario municipalities, from a number of sources including land title documents, building permits, and in-persons assessments by professional assessors. All residential properties are assessed at least once every four years[8]. The geographic centroid of each property was used to assign each property to a Dissemination Area.

Structural condition

MPAC classifies the structures on a property using a range from poor to good. These classification codes were used to calculate the indicator: "% of residential households in fair/poor condition". Fair Condition and Poor Condition are defined by MPAC as below:

Fair Condition

A structure is in fair condition if it has not received normal maintenance and is showing signs of neglect. The neglect would be sufficient to impede the marketability (resale value) of the house.

Poor Condition

A structure is in poor condition if it has received no maintenance, it has been abused and displays a significant amount of abnormal deterioration, which would require a major expense to cure (fix).

Registered Persons Database

Description

The Registered Persons Database (RPDB) is a record-level database maintained by the Ministry of Health and Long-Term Care which contains demographic information on residents of Ontario eligible for the Ontario Health Insurance Plan (OHIP). The RPDB contains demographic information including individual's sex, age, current and historical residential address. Since eligibility for OHIP is free, RPDB coverage is generally high. Some residents may not be included in the RPDB, including people covered by other health plans (e.g., members of the Canadian Forces or prison inmates), and individuals who have not lived in the province for at least three months. Additionally, individuals remain in the RPDB for a period of 3 months after they leave the province. Dissemination Area of residence was derived from Postal Code by using the Statistics Canada Postal Code Conversion (PCCF) + program.

Immigration, Refugees, and Citizenship Canada Permanent Resident Database

Description

The Immigration, Refugee and Citizenship Canada (IRCC) Permanent Resident Database contains demographic information for all legal immigrants to Canada, including date of landing, age, country of birth, and mother tongue. The database is updated annually, and historical data is available for the years 1985-2012.

Geocoding and linkage

The IRCC permanent resident database captures information on individual immigrants at arrival, but is not updated to include current address residence in the years following initial immigration to Canada. Current residency status is established via secured linkage with the RPDB (described above) using unique encoded identifiers and analyzed at the Institute for Clinical Evaluative Sciences (ICES).Dissemination area of residence is then determined via PCCF+.

Ethnicity

Ethnicity is not among the demographic data collected by the IRCC and reported on in the permanent residence database. Rezai *et al.*[9] have successfully classified individuals in the IRCC database into standard Statistics Canada ethnicity categories using the country of birth and mother tongue information recorded by the IRCC. Additional classification is conducted by utilizing surname lists to identify South Asian and Chinese ethnicity of immigrants developed by Shah *et al*.[10] Individuals are categorized as belonging to a visible minority using the Statistics Canada definition of "persons, other than aboriginal peoples, who are non-Caucasian in race or non-white in colour."[11]

References

1. 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;103:3-5. Available from: http://journal.cpha.ca/index.php/cjph/article/view/3096/2665

2. McIsaac KE, Matheson FI. The Canadian marginalization index in the era of the National Household Survey [Forthcoming].

3. Turney K, Harknett K. Neighborhood disadvantage, residential stability, and perceptions of instrumental support among new mothers. J Fam Issues [Internet]. 2011;31(4):499–524. Available from: http://journals.sagepub.com/doi/10.1177/0192513X09347992

4. Tøge AG, Bell R. Material deprivation and health: a longitudinal study. BMC Public Health [Internet]. 2016;16(1):747. Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-016-3327-z

5. 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;71(7):625–32. Available from: http://jech.bmj.com/lookup/doi/10.1136/jech-2016-208525

6. Nestel S. Colour coded health care: the impact of race and racism on Canadians' health [Internet]. Toronto, ON: Wellesley Institute; 2012 [cited 2017 Dec 12]. Available from: http://www.wellesleyinstitute.com/wp-content/uploads/2012/02/Colour-Coded-Health-Care-Sheryl-Nestel.pdf

7. Statistics Canada. Dissemination area data quality note: T1FF data produced on census geography. Ottawa, ON: Her Majesty the Queen in Right of Canada; 2013.

8. Municipal Property Assessment Corporation. Methodology guide: valuing residential properties in Ontario [Internet]. Pickering, ON: Municipal Property Assessment Corporation; 2016 [cited 2017 Dec 4]. Available from: https://www.mpac.ca/sites/default/files/imce/pdf/MGValuingResidentialPropertiesInOntario.pdf

9. Rezai MR, Maclagan LC, Donovan LR, Tu J V. Classification of Canadian immigrants into visible minority groups using country of birth and mother tongue. Open Med. 2013;7(4):85-93.Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4161499/

10. Shah BR, Chiu M, Amin S, Ramani M, Sadry S, Tu J V, et al. Surname lists to identify South Asian and Chinese ethnicity from secondary data in Ontario, Canada: a validation study. BMC Med Res Methodol [Internet]. 2010;10(1):42. Available from: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-10-42

11. Statistics Canada. Visible minority and population group reference guide. Ottawa, ON: Government of Canada; 2011 [cited 2017 Dec 4]. Available from: http://www12.statcan.gc.ca/nhs-enm/2011/ref/guides/99-010-x/99-010-x2011009-eng.cfm

Disclaimers

St. Michael's Hospital

This document was developed by The Centre for Urban Health Solutions (C-UHS), at St. Michael's Hospital.

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

Public Health Ontario

This document was developed by Public Health Ontario (PHO). PHO provides scientific and technical advice to Ontario's government, public health organizations and health care providers. PHO's work is guided by the current best available evidence at the time of publication.

The application and use of this document is the responsibility of the user. PHO assumes no liability resulting from any such application or use.

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

Institute for Clinical Evaluative Sciences (ICES)

This study was supported by the Institute for Clinical Evaluative Sciences (ICES), which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC). The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding sources. No endorsement by ICES or the Ontario MOHLTC is intended or should be inferred.

These datasets were linked using unique encoded identifiers and analyzed at the Institute for Clinical Evaluative Sciences (ICES).

Ethical Approval

This study was approved by the institutional review board at Sunnybrook Health Sciences Centre, Toronto, Canada, the St. Michael's Hospital Research Ethics Board, and the Ethics Review Board of the Ontario Agency for Health Protection and Promotion (Public Health Ontario).

About the author organizations

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

The Centre for Urban Health Solutions is an inter-disciplinary research centre within St. Michael's Hospital in 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 Centre for Urban Health Solutions website.

Public Health Ontario

Public Health Ontario is a Crown corporation dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, frontline health workers and researchers to the best scientific intelligence and knowledge from around the world.

Public Health Ontario provides expert scientific and technical support to government, local public health units and health care providers relating to the following:

- communicable and infectious diseases
- infection prevention and control
- environmental and occupational health
- emergency preparedness
- health promotion, chronic disease and injury prevention
- public health laboratory services

Public Health Ontario's work also includes surveillance, epidemiology, research, professional development and knowledge services. For more information, visit publichealthontario.ca.

Public Health Ontario acknowledges the financial support of the Ontario Government.