

Development of the Canadian Marginalization Index: A New Tool for the Study of Inequality

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ABSTRACT

Objectives: Area-based measures of socio-economic status are increasingly used in population health research. Based on previous research and theory, the Canadian Marginalization Index (CAN-Marg) was created to reflect four dimensions of marginalization: residential instability, material deprivation, dependency and ethnic concentration. The objective of this paper was threefold: to describe CAN-Marg; to illustrate its stability across geographic area and time; and to describe its association with health and behavioural problems.

Methods: CAN-Marg was created at the dissemination area (DA) and census tract level for census years 2001 and 2006, using factor analysis. Descriptions of 18 health and behavioural problems were selected using individual-level data from the Canadian Community Health Survey (CCHS) 3.1 and 2007/08. CAN-Marg quintiles created at the DA level (2006) were assigned to individual CCHS records. Multilevel logistic regression modeling was conducted to examine associations between marginalization and CCHS health and behavioural problems.

Results: The index demonstrated marked stability across time and geographic area. Each of the four dimensions showed strong and significant associations with the selected health and behavioural problems, and these associations differed depending on which of the dimensions of marginalization was examined.

Conclusion: CAN-Marg is a census-based, empirically derived and theoretically informed tool designed to reflect a broader conceptualization of Canadian marginalization.

Key words: Socio-economic status; health; methods; marginalization; inequities

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The use of area-based indicators of socio-economic status has a long history, and as more databases become available and interest in population health research and monitoring grows, so does the use of so-called “area-based deprivation indices” or ABDIs.¹ As a result of this growing interest, the Canadian Marginalization Index (CAN-Marg) was developed from existing area-based research and theory linking neighbourhood marginalization with poor health. Developed by a Toronto-based research team in 2006, the CAN-Marg is a census-based, geographically derived index for use in research that seeks to understand inequalities in health and other social problems related to health among either population groups or geographic areas.

CAN-Marg goes beyond the traditional definitions of exclusion primarily captured by past and current ABDIs.²⁻⁹ Most existing ABDIs have a strong focus on aspects of material deprivation, such as income, car ownership and home ownership. This focus is based on a model that emphasizes economic inequality as paramount. However, as societies in the affluent countries of the world have changed over the past 30-40 years, there are other facets of inequality that may be just as important for health. CAN-Marg, therefore, is a multifaceted index, allowing researchers and policy and program analysts to examine multiple dimensions of marginalization in urban and rural Canada and the effects of those dimensions of inequality on health and other social outcomes. CAN-Marg has been developed with reference to marginalization, which is a process that creates inequalities along multiple axes of social dif-

ferentiation in Canada.¹⁰ The four dimensions included in the index are residential instability, material deprivation, ethnic concentration and dependency.

CAN-Marg was developed by building initially on a theoretical framework based on previous work in the field of deprivation and marginalization, but in its development we also allowed for the possibility that other forms of marginalization, for example, marginalization by ethno-racial identity, immigration status, life-cycle

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Table 1. Factor Loadings (FL) and Correlations (R) for the Four Dimensions of CAN-Marg

	Census Tracts				Dissemination Areas			
	2001		2006		2001		2006	
	FL	R	FL	R	FL	R	FL	R
Residential Instability								
Proportion living alone	96	0.94	96	0.95	89	0.89	90	0.90
Proportion of youth population aged 5-15*	95	0.88	79	0.66	74	0.71	70	0.65
Crowding: Average number of persons per dwelling*	93	0.90	92	0.89	87	0.83	86	0.82
Proportion multi-unit housing	80	0.87	81	0.88	85	0.87	85	0.87
Proportion of the population that is married/common-law*	75	0.89	71	0.87	80	0.87	78	0.85
Proportion of dwellings that are owned*	71	0.87	69	0.87	80	0.86	78	0.85
Proportion of residential mobility (same house as 5 years ago)	61	0.60	56	0.54	68	0.63	60	0.55
Material Deprivation								
Proportion 25+ without certificate, diploma or degree	90	0.77	89	0.74	76	0.72	76	0.72
Proportion of lone-parent families	82	0.85	82	0.84	52	0.59	51	0.58
Proportion government transfer payment	77	0.87	52	0.49	70	0.80	70	0.79
Proportion unemployment 15+	72	0.78	61	0.72	70	0.69	64	0.63
Proportion below low income cut-off	65	0.86	49	0.78	51	0.71	39	0.60
Proportion of homes needing major repair	56	0.54	68	0.68	57	0.49	57	0.52
Dependency								
Proportion of seniors (65+)	88	0.90	89	0.91	88	0.91	89	0.92
Dependency ratio (0-14 + 65+)/(15-64)	91	0.86	92	0.89	79	0.69	84	0.77
Labour force participation rate (aged 15 and older)*	78	0.83	80	0.84	78	0.79	76	0.78
Ethnic Concentration								
Proportion of 5-year recent immigrants	95	0.93	93	0.92	88	0.84	85	0.83
Proportion of visible minority	97	0.93	96	0.90	96	0.89	94	0.87

* Reverse coded

stage and household composition, could be included empirically.^{2,9} With this expanded theoretical conception of the different forms of marginalization in contemporary society, a broader set of potential census indicators were assembled and the index was then empirically derived using principal components factor analysis.^{11,12} Our desire was to create an index that captured the nature of between-place variation in a broad set of marginalization indicators and that was independent of any association with health outcomes, so as to avoid any circular or tautological reasoning (i.e., the argument that the index is a good measure for use in health research because it is associated with health). That said, later in this paper we do show its performance in predicting population health outcomes.

The purpose of this paper is to describe CAN-Marg, show its stability across time periods and across geographic areas (e.g., cities and rural areas), and illustrate its association with health and behavioural outcomes. The latter is an important aspect of the project since CAN-Marg itself does not contain health information, yet many researchers have found that marginalization, as measured by area-based composite indices, correlates strongly with measures of health status.^{8,9,13-18}

Creating the Canadian Marginalization Index

The selection of neighbourhood characteristics for this analysis was guided by previous research on ABDIs^{6,9,17,19} and on contemporary theoretical perspectives on inequality and marginalization in Canadian society.^{10,20} The literature on deprivation and residential instability was pivotal as a starting point and provided the input variables for factor analysis.^{6,9,10,17,19,20} The initial analysis was conducted using 2001 census tract (CT) data (urban areas). In total, 42 measures from the census data were created for input into factor analysis. Measures with low factor loadings were removed on an iterative basis, after which four factors emerged with 18 CT measures remaining. Factors were constructed using oblique rotation, which allows the factors to co-vary.^{11,12,21} We also estimated an orthogonal factor matrix that yielded substantively identical

Table 2. Eigenvalues and Variance Explained for the Four Dimensions of CAN-Marg

Marginalization Dimension	Census Tracts		Dissemination Areas	
	2001	2006	2001	2006
Residential Instability				
Eigenvalue	7.92	7.03	6.31	6.02
Proportion of variance explained	0.44	0.39	0.35	0.33
Material Deprivation				
Eigenvalue	2.77	2.75	2.96	1.95
Proportion of variance explained	0.15	0.15	0.16	0.11
Dependency				
Eigenvalue	2.31	1.60	2.09	2.99
Proportion of variance explained	0.13	0.09	0.12	0.17
Ethnic Concentration				
Eigenvalue	1.55	2.20	1.48	1.54
Proportion of variance explained	0.09	0.12	0.08	0.09

results. We repeated factor analysis using the same 18 census measures for dissemination areas (DAs) (2001 and 2006) and 2006 CTs.

Table 1 shows the indicators associated with each dimension of marginalization. The correlations between the indicators and their respective marginalization dimensions were fairly stable across time and geographic area, the majority being above 0.65. The factor loadings were also fairly stable (most >0.50). Those for proportion below the low income cut-off (see material deprivation) were lower in 2006 (<0.50). Historically, income has been a primary component of deprivation indices, so there is a theoretical rationale for its placement in the deprivation dimension.^{3,4,19} In general, however, the factor loadings and eigenvalues were similar within dimensions by year and geographic area, and the percentage variance explained by the four dimensions ranged from 70% to 80% (Table 2). Residential instability was the dominant dimension with the highest eigenvalues of the four dimensions, followed by material deprivation, dependency and ethnic concentration.

Factor loadings were used to compute factor scores, which allowed us to create a separate continuous index for each of the four dimensions. Each dimension is an asymmetrically standard-

Table 3. Mixed Regression Model Results from Merged CAN-Marg and Combined CCHS 3.1 and 2007/08, Canada

Outcome	Quintile	Odds Ratios (confidence intervals)			
		Residential Instability	Material Deprivation	Dependency	Ethnic Concentration
Health Behaviours					
Binge drinking (>5 drinks ≥once/month)	Q2	1.07 (1.02,1.11)	0.99 (0.95,1.03)	0.86 (0.83,0.90)	1.05 (1.01,1.09)
	Q3	1.06 (1.02,1.11)	1.01 (0.97,1.05)	0.82 (0.79,0.86)	1.06 (1.03,1.11)
	Q4	1.06 (1.02,1.11)	1.01 (0.97,1.05)	0.80 (0.77,0.84)	1.06 (1.02,1.10)
	Q5	1.09 (1.05,1.14)	1.06 (1.02,1.11)	0.70 (0.67,0.73)	0.79 (0.75,0.82)
Overweight (BMI* ≥25 kg/m ²)	Q2	1.15 (1.11,1.18)	1.12 (1.09,1.15)	1.04 (1.01,1.07)	0.92 (0.89,0.94)
	Q3	1.13 (1.10,1.17)	1.19 (1.15,1.23)	1.12 (1.09,1.15)	0.84 (0.81,0.86)
	Q4	1.09 (1.06,1.13)	1.24 (1.20,1.27)	1.22 (1.18,1.25)	0.78 (0.76,0.80)
	Q5	0.93 (0.91,0.96)	1.35 (1.31,1.39)	1.29 (1.25,1.33)	0.64 (0.62,0.66)
Flu shot in past year	Q2	1.09 (1.05,1.14)	1.01 (0.97,1.05)	1.22 (1.18,1.27)	0.99 (0.96,1.02)
	Q3	1.10 (1.06,1.14)	0.98 (0.94,1.01)	1.34 (1.30,1.39)	0.95 (0.92,0.99)
	Q4	1.17 (1.13,1.21)	0.97 (0.94,1.01)	1.44 (1.39,1.49)	0.87 (0.84,0.90)
	Q5	1.17 (1.13,1.21)	0.89 (0.86,0.92)	1.81 (1.75,1.87)	0.86 (0.83,0.90)
Current smoker	Q2	1.24 (1.19,1.30)	1.35 (1.29,1.41)	0.93 (0.89,0.97)	0.98 (0.94,1.02)
	Q3	1.40 (1.34,1.46)	1.61 (1.54,1.68)	0.97 (0.93,1.01)	1.00 (0.96,1.04)
	Q4	1.57 (1.51,1.64)	1.89 (1.81,1.97)	0.98 (0.94,1.02)	0.99 (0.96,1.03)
	Q5	1.74 (1.67,1.82)	2.44 (2.35,2.54)	0.93 (0.89,0.97)	0.83 (0.79,0.86)
Inactive	Q2	1.09 (1.05,1.13)	1.16 (1.12,1.19)	1.01 (0.98,1.05)	0.94 (0.91,0.97)
	Q3	1.13 (1.10,1.17)	1.29 (1.25,1.33)	1.06 (1.03,1.10)	0.91 (0.88,0.94)
	Q4	1.18 (1.14,1.22)	1.44 (1.40,1.49)	1.11 (1.08,1.15)	0.89 (0.86,0.92)
	Q5	1.32 (1.27,1.36)	1.62 (1.57,1.67)	1.23 (1.19,1.27)	1.02 (0.99,1.06)
Disability/activity limitation (sometimes/often)	Q2	1.21 (1.17,1.25)	1.16 (1.12,1.20)	1.12 (1.09,1.16)	0.95 (0.92,0.98)
	Q3	1.31 (1.26,1.35)	1.25 (1.21,1.30)	1.24 (1.20,1.28)	0.90 (0.87,0.93)
	Q4	1.41 (1.36,1.46)	1.32 (1.28,1.37)	1.37 (1.33,1.42)	0.81 (0.78,0.84)
	Q5	1.49 (1.44,1.54)	1.47 (1.42,1.52)	1.67 (1.62,1.72)	0.71 (0.69,0.74)
Health Outcomes					
Asthma	Q2	1.03 (0.98,1.08)	1.04 (0.99,1.10)	0.96 (0.91,1.00)	1.06 (1.02,1.11)
	Q3	1.08 (1.03,1.14)	1.05 (1.00,1.10)	0.97 (0.93,1.02)	1.06 (1.02,1.11)
	Q4	1.12 (1.07,1.18)	1.14 (1.08,1.19)	0.98 (0.93,1.02)	1.09 (1.05,1.14)
	Q5	1.20 (1.14,1.26)	1.23 (1.17,1.28)	0.96 (0.92,1.01)	0.97 (0.92,1.02)
Hypertension	Q2	1.25 (1.20,1.31)	1.14 (1.10,1.19)	1.38 (1.33,1.44)	0.90 (0.87,0.93)
	Q3	1.37 (1.31,1.42)	1.28 (1.23,1.33)	1.64 (1.57,1.70)	0.78 (0.75,0.81)
	Q4	1.37 (1.32,1.43)	1.37 (1.32,1.42)	1.93 (1.86,2.00)	0.65 (0.63,0.68)
	Q5	1.39 (1.33,1.44)	1.47 (1.41,1.52)	2.51 (2.42,2.60)	0.60 (0.58,0.62)
Diabetes	Q2	1.27 (1.19,1.35)	1.36 (1.28,1.45)	1.30 (1.22,1.39)	0.93 (0.89,0.98)
	Q3	1.38 (1.30,1.47)	1.58 (1.49,1.68)	1.51 (1.42,1.61)	0.85 (0.81,0.89)
	Q4	1.42 (1.34,1.51)	1.67 (1.57,1.77)	1.85 (1.74,1.96)	0.72 (0.68,0.76)
	Q5	1.52 (1.44,1.61)	1.97 (1.86,2.08)	2.17 (2.05,2.29)	0.73 (0.69,0.77)
Heart disease	Q2	1.30 (1.22,1.39)	1.19 (1.12,1.27)	1.47 (1.38,1.58)	0.89 (0.85,0.94)
	Q3	1.49 (1.40,1.59)	1.36 (1.28,1.45)	1.87 (1.75,2.00)	0.80 (0.76,0.84)
	Q4	1.55 (1.45,1.64)	1.48 (1.39,1.57)	2.27 (2.13,2.42)	0.62 (0.59,0.66)
	Q5	1.77 (1.66,1.88)	1.65 (1.55,1.74)	3.12 (2.94,3.31)	0.55 (0.51,0.58)
COPD* (age 30+)	Q2	1.23 (1.08,1.42)	1.20 (1.05,1.37)	1.24 (1.08,1.43)	1.02 (0.92,1.13)
	Q3	1.30 (1.14,1.49)	1.25 (1.10,1.42)	1.35 (1.17,1.55)	1.02 (0.92,1.14)
	Q4	1.34 (1.17,1.53)	1.35 (1.18,1.53)	1.45 (1.27,1.66)	0.88 (0.78,0.99)
	Q5	1.65 (1.45,1.89)	1.39 (1.22,1.57)	1.71 (1.51,1.94)	0.72 (0.63,0.83)
Emphysema (age 30+)	Q2	1.29 (1.11,1.52)	1.35 (1.15,1.60)	1.34 (1.14,1.57)	0.88 (0.78,0.98)
	Q3	1.53 (1.32,1.78)	1.74 (1.50,2.04)	1.48 (1.26,1.73)	0.90 (0.80,1.01)
	Q4	1.66 (1.43,1.93)	2.08 (1.79,2.41)	1.76 (1.52,2.05)	0.79 (0.70,0.90)
	Q5	2.17 (1.87,2.51)	2.40 (2.07,2.77)	2.20 (1.91,2.53)	0.64 (0.55,0.75)
Chronic bronchitis	Q2	1.35 (1.22,1.48)	1.20 (1.09,1.33)	1.10 (1.01,1.21)	0.95 (0.88,1.02)
	Q3	1.55 (1.41,1.70)	1.59 (1.45,1.74)	1.28 (1.17,1.40)	0.92 (0.85,0.99)
	Q4	1.69 (1.54,1.85)	1.77 (1.61,1.94)	1.42 (1.30,1.54)	0.83 (0.77,0.90)
	Q5	1.99 (1.82,2.18)	2.28 (2.09,2.48)	1.61 (1.49,1.75)	0.80 (0.74,0.88)
Mood disorder/anxiety	Q2	1.12 (1.07,1.18)	1.13 (1.08,1.19)	0.92 (0.88,0.97)	1.08 (1.03,1.13)
	Q3	1.21 (1.16,1.28)	1.17 (1.11,1.23)	0.95 (0.90,1.00)	1.15 (1.10,1.20)
	Q4	1.35 (1.28,1.42)	1.23 (1.17,1.29)	0.96 (0.92,1.01)	1.18 (1.12,1.23)
	Q5	1.73 (1.64,1.81)	1.45 (1.38,1.52)	0.97 (0.93,1.01)	1.09 (1.04,1.14)
Self-reported Health/Perceptions					
Self-perceived stress (quite a bit/extremely)	Q2	0.91 (0.88,0.94)	0.98 (0.95,1.02)	0.94 (0.91,0.97)	1.07 (1.03,1.10)
	Q3	0.91 (0.87,0.94)	0.98 (0.94,1.01)	0.89 (0.86,0.92)	1.18 (1.14,1.21)
	Q4	0.94 (0.90,0.97)	0.97 (0.94,1.01)	0.81 (0.79,0.84)	1.25 (1.21,1.29)
	Q5	1.04 (1.00,1.07)	0.93 (0.90,0.96)	0.73 (0.71,0.76)	1.31 (1.27,1.36)
Self-rated health (poor/fair)	Q2	1.26 (1.20,1.32)	1.31 (1.25,1.37)	1.17 (1.12,1.23)	0.92 (0.88,0.95)
	Q3	1.44 (1.37,1.51)	1.57 (1.50,1.64)	1.37 (1.31,1.44)	0.85 (0.81,0.88)
	Q4	1.59 (1.52,1.67)	1.85 (1.77,1.93)	1.54 (1.47,1.61)	0.78 (0.75,0.82)
	Q5	1.87 (1.79,1.96)	2.35 (2.25,2.45)	1.95 (1.87,2.03)	0.83 (0.80,0.87)
Self-rated mental health (poor/fair)	Q2	1.16 (1.08,1.24)	1.20 (1.12,1.29)	0.95 (0.89,1.01)	0.98 (0.93,1.04)
	Q3	1.21 (1.13,1.29)	1.32 (1.23,1.41)	0.99 (0.93,1.06)	1.01 (0.95,1.07)
	Q4	1.45 (1.36,1.55)	1.52 (1.43,1.63)	1.01 (0.95,1.07)	1.07 (1.01,1.14)
	Q5	1.76 (1.65,1.88)	1.87 (1.76,2.00)	1.06 (0.99,1.12)	1.23 (1.15,1.30)
Sense of community belonging (strong/somewhat strong)	Q2	1.00 (0.96,1.04)	0.98 (0.94,1.02)	1.14 (1.10,1.19)	0.87 (0.84,0.90)
	Q3	1.00 (0.96,1.04)	0.98 (0.94,1.01)	1.21 (1.17,1.26)	0.80 (0.78,0.83)
	Q4	0.91 (0.88,0.95)	0.94 (0.90,0.97)	1.32 (1.27,1.37)	0.67 (0.64,0.69)
	Q5	0.67 (0.64,0.69)	0.97 (0.93,1.00)	1.48 (1.43,1.54)	0.60 (0.57,0.62)

Note: Q1 is the reference category for all outcomes.

* BMI = body mass index; COPD = chronic obstructive pulmonary disease.

ized scale. For the purposes of this paper, the factor scores are used as quintiles. CAN-Marg quintiles were generated by ordering DAs according to increasing marginalization and allocating an equal number of DAs to each quintile. These were created by sorting the marginalization data into five groups, ranked from 1 (least marginalized) to 5 (most marginalized). Each group contains a fifth of the geographic units. For example, if an area has a value of 5 on the material deprivation scale, it means it is in the most deprived 20% of areas in Canada.²²

Associations between marginalization and health/behavioural outcomes

We next examined the relation between the four dimensions of the 2006 CAN-Marg Index and 18 health and behavioural outcomes using multilevel modeling with DAs as the area-level unit of analysis. Individual-level data were derived from 2 cycles (cycle 3.1 and cycle 2007/08) of the Canadian Community Health Survey (CCHS), a cross-sectional nationally representative survey that provides detailed information on health determinants and outcomes for individuals.²³ The CCHS 2007/2008 respondents had 2006 DAs in the data set, whereas cycle 3.1 (2005) had 2001 DAs. In this cycle, 2001 geographic areas were converted to 2006 geographic areas using the postal code-DA assignment in cycle 2007/08 and the Postal Code Conversion File Plus (version 5H), which provides an algorithm to assign census geographic areas on the basis of postal codes.²⁴

Statistical approach

Descriptive analyses were weighted using the combined sampling weight provided by Statistics Canada. Prevalence rates were weighted and shown with weighted sample frequencies. Our approach to evaluating the association between marginalization and CCHS health and behavioural outcomes was to use multilevel modeling, which takes into account the potential for clustered observations within geographic areas and allowed us to assess the extent to which each outcome varies across geographic areas.^{25,26} We performed a series of multi-level logistic random intercept regression models. All analyses were conducted using the SAS procedure NLMIXED, version 9.3 (SAS Institute Inc., Cary, NC, US). Data publication guidelines of Statistics Canada were followed throughout the analysis. Ethics approval was obtained from the St Michael's Hospital Research Ethics Review Board.

RESULTS

Table 3 shows odds ratios for each health and behavioural outcome by quintile for each dimension of CAN-Marg. A quintile value of 5 reflects the greatest magnitude of marginalization (i.e., the most marginalized) and a quintile of 1 (the reference category) the least magnitude for each dimension (i.e., ethnic concentration, residential instability, material deprivation, dependency).

Table 3 shows that health and behavioural outcomes differ, depending on how marginalization is conceived of and measured. In most cases, living in areas with higher residential instability was significantly associated with greater health/behavioural problems such as binge drinking, smoking, disability, chronic diseases, low physical activity, and poor self-rated physical/mental health. Two exceptions were flu shots in the previous year and being overweight; in these cases, higher residential instability was associated

with a lower likelihood of being overweight and a greater likelihood of having had a flu shot.

With the exception of self-perceived stress, living in areas with higher material deprivation was significantly associated with worse physical and mental health outcomes. Higher material deprivation was also associated with being overweight, being physically inactive, smoking, binge drinking, disability, and a lower likelihood of having had a flu shot in the previous year.

Living in areas with higher dependency was positively associated with being overweight, with disability, an inactive lifestyle, and having had a flu shot in the previous year. There was a greater risk of reporting chronic physical health problems and poor self-rated physical and mental health, and a lower risk of reporting binge drinking, self-perceived stress, smoking, and having a mood/anxiety disorder.

Ethnic concentration was associated with different outcomes from the other three dimensions in many cases. Living in areas with higher ethnic concentration was significantly associated with better health outcomes and more healthy behaviours. This was noted particularly for binge drinking, smoking, disability, chronic physical and mental health, and self-rated physical health. Only in the cases of high self-perceived stress and poor self-rated mental health was living in areas of higher ethnic concentration associated with poorer health.

Residential instability, material deprivation and ethnic concentration were negatively related to strong sense of community belonging, whereas dependency showed the reverse, higher dependency being associated with a greater sense of community belonging.

DISCUSSION

Because health inequalities are large in Canadian society and in many cases avoidable, there is an urgent need for accessible, census-based empirical tools in health inequalities research, like ABDIs that reflect contemporary patterns of social differentiation. The ABDIs developed in the past reflected what were important axes of social differentiation and marginalization of the time. In Canada, patterns of immigration, language, ethnicity, household size and structure, etc., are all associated with health and/or health care outcomes and are profoundly different than they were when the early ABDIs were developed. Consequently, we developed CAN-Marg to fill the need for an empirically derived, theoretically informed tool that is current with contemporary social forces and marginalization processes.

Empirical demonstrations of CAN-Marg in this and in previous studies using the tool reinforce the premise that underpinned its development:^{13-15,27-30} different processes of marginalization and axes of social differentiation relate to health in ways that differ from those associated with the enduring construct of material deprivation, reinforcing the need for a tool like CAN-Marg.

REFERENCES

1. Schuurman N, Bell N, Dunn J, Oliver L. Deprivation indices, population health and geography: An evaluation of the spatial effectiveness of indices at multiple scales. *J Urban Health* 2007;84(4):591-603.
2. Townsend PDN. *Inequalities in Health: The Black Report*. Harmondsworth, UK: Penguin, 1982.
3. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: Concepts, methodologies, and guidelines. *Annu Rev Public Health* 1997;18(1):341-78.

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4. Broadway MJ, Jesty G. Are Canadian inner cities becoming more dissimilar? An analysis of urban deprivation indicators. *Urban Stud* 1998;35(9):1423-38.
5. Frohlich N, Mustard C. A regional comparison of socioeconomic and health indices in a Canadian province. *Soc Sci Med* 1996;42(9):1273-81.
6. Carstairs V, Morris R. Deprivation and health. *BMJ* 1989;299(6713):1462.
7. Jarman B. Underprivileged areas: Validation and distribution of scores. *BMJ* 1984;289(6458):1587-92.
8. Morris R, Carstairs V. Which deprivation? A comparison of selected deprivation indexes. *J Public Health Med* 1991;13(4):318-26.
9. Crampton PSC, Sutton F. NZDep91 Index of Deprivation Instruction Book. Wellington: Health Services Research Centre, New Zealand, 1997.
10. MacLeod CM, Eisenberg A. The normative dimensions of equality. In: Green DA, Kesselman JR (Eds.), *Dimensions of Inequality in Canada*. Vancouver, BC: UBC Press, 2006;33-64.
11. Kim JO, Mueller CW. *Factor Analysis: Statistical Methods and Practical Issues*. Beverly Hills, CA: Sage Publications, 1978.
12. Kim JO, Mueller CW. *Introduction to Factor Analysis: What It Is and How To Do It*. Beverly Hills: Sage Publications, 1978.
13. 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):e4.
14. 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* 2009;99(2):285-93.
15. Matheson FI, Moineddin R, Dunn JR, Creatore MI, Gozdyra P, Glazier RH. Urban neighborhoods, chronic stress, gender and depression. *Soc Sci Med* 2006;63(10):2604-16.
16. McLoone P, Boddy FA. Deprivation and mortality in Scotland, 1981 and 1991. *BMJ* 1994;309(6967):1465-70.
17. Townsend P, Phillimore P, Beattie A. *Health and Deprivation: Inequality and the North*. New York, NY: Croom Helm, 1988.
18. Eames M, Ben-Shlomo Y, Marmot MG. Social deprivation and premature mortality: Regional comparison across England. *BMJ* 1993;307(6912):1097-102.
19. Pampalon R, Raymond G. A deprivation index for health and welfare planning in Quebec. *Chronic Dis Can* 2000;21(3):104-13.
20. Grabb EG, Guppy LN (Eds.). *Social Inequality in Canada: Patterns, Problems, and Policies*, 5th ed. Scarborough, ON: Prentice-Hall Canada, 2009.
21. Braithwaite RL, Treadwell HM, Arriola KR. Health disparities and incarcerated women: A population ignored. *Am J Public Health* 2005;95(10):1679-81.
22. Matheson FI, Dunn JR, Smith KL, Moineddin R, Glazier RH. Canadian Marginalization Index User Guide. Hamilton, ON: McMaster University, 2011. Available at: http://www.crunch.mcmaster.ca/documents/CAN-Marg_user_guide_1.0_FINAL_MAY2012.pdf (Accessed August 13, 2012).
23. Beland Y. Canadian Community Health Survey – Methodological overview. *Health Rep* 2002;13(3):9-14.
24. Wilkins R, Khan S. PCCF + Version 5H User's Guide: Automated Geographic Coding Based on the Statistics Canada Postal Code Conversion Files Including Postal Codes through October 2010. Ottawa: Health Statistics Division, Statistics Canada, 2011. Catalogue no. 82F0086-XDB.
25. Hox JJ. *Applied Multilevel Analysis*. Amsterdam, Netherlands: TT-Publikaties, 1995.
26. Raudenbush SW, Sampson R. Assessing direct and indirect effects in multilevel designs with latent variables. *Sociol Methods Res* 1999;28(2):123-53.
27. 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* 2008;66(3):675-90.
28. 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* 2009;64(8):705-13.
29. Matheson FI, LaFreniere MC, White HL, Moineddin R, Dunn JR, Glazier RH. Influence of neighborhood deprivation, gender and ethno-racial origin on smoking behavior of Canadian youth. *Prev Med* 2011;52(5):376-80.
30. 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? *Health & Place* 2011;17(1):361-69.