

Health Reports

Gentrification, Urban Interventions and Equity (GENUINE): A map-based gentrification tool for Canadian metropolitan areas

by Caislin L. Firth, Benoit Thierry, Daniel Fuller, Meghan Winters, and Yan Kestens

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ABSTRACT

Background

Researchers, policy makers, and urban planners require tools to better understand the complex relationship between gentrification and health. The Gentrification, Urban Interventions and Equity (GENUINE) tool is an open-access, map-based tool that allows users to explore measures of gentrification for Canadian cities and incorporate them into their work.

Data and methods

The phenomenon of gentrification has manifested differently across cities. The GENUINE tool was developed to include four distinct gentrification measures that have been used in the United States and Canada and that rely on different combinations of change in census indicators related to income, housing, occupation, education and age. The measures were computed for all census tracts within the 36 Canadian census metropolitan areas to identify gentrifiable areas in 2006 and those that gentrified between 2006 and 2016.

Results

Depending on the measure, by 2016, 2% to 20% of census tracts had experienced gentrification, corresponding to between 2% (418,065 people) and 17% (4,266,434) of the Canadian population living in gentrified areas. Generally, metropolitan areas with populations over 1 million people had a greater proportion of their population living in gentrified areas (2% to 18%) compared with metropolitan areas with fewer than 250,000 residents (1% to 14%).

Interpretation

With attention on healthy cities only expanding, GENUINE provides pan-Canadian indicators of gentrification, which can be an integral part of solution-oriented research and advancing cities toward designing healthy and equitable communities.

Keywords

gentrification, neighbourhood, housing, income, urban change, measurement, equity

AUTHORS

Caislin L. Firth (caislin_leah_firth@sfu.ca) is with Simon Fraser University, Burnaby, British Columbia. Benoit Thierry (benoit.thierry@crchum.qc.ca) is with Université de Montréal/Centre de recherche du CHUM, Pavillon S, Montréal, Québec. Daniel Fuller (dfuller@mun.ca) is with Memorial University of Newfoundland, St. John's, Newfoundland and Labrador. Meghan Winters (mwinters@sfu.ca) is with Simon Fraser University, Burnaby, British Columbia. Yan Kestens (yan.kestens@umontreal.ca) is with Université de Montréal/Centre de recherche du CHUM, Pavillon S, Montréal, Québec.

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What is already known on this subject?

- Gentrification transforms the physical, social, and economic environments of neighbourhoods, and this can have beneficial effects for some residents and harmful effects for others.
- To date, most gentrification measures and health impact studies have not focused on Canadian cities.
- Canadian cities need quantitative gentrification measures that are reproducible over time and facilitate comparisons between cities.

What does this study add?

- The Gentrification, Urban Interventions, and Equity (GENUINE) tool is an open-access, map-based tool for Canadian census metropolitan areas.
- Depending on the measure, between 2% (418,065 people) and 17% (4,266,434) of the Canadian population were living in gentrified areas in 2016.
- The GENUINE tool will evolve through the longitudinal tracking of gentrification with the upcoming census and the addition of complementary indicators, and this could help identify gentrification-related processes, possible causes and consequences.

Urban renewal provides huge potential for improving population health in cities, but it may also carry unintended consequences for health equity. Health inequities may be reinforced by a lack of investment in disadvantaged neighbourhoods and also by unexpected gentrification processes. Gentrification is an area-level process in which formerly declining, under-resourced neighbourhoods experience reinvestment and in-migration of increasingly affluent new residents.¹⁻³ There may be a multitude of consequences when the physical, social and economic environments of neighbourhoods are transformed by the gentrification process.^{4,5} In Canada, both the causes and consequences of gentrification have been explored in studies that shed light on who benefits from and who is harmed by such neighbourhood changes. Within Canadian cities, gentrification may be signalled by specific built-environment changes, such as greater access to rapid transit systems⁶ and green space,⁷ which have been associated with gentrifying areas. The social fabric of neighbourhoods is impacted by gentrification through declining social mix, ethnicity diversity and immigrant concentration,⁸ as well as by increasing housing evictions.⁹ However, increased collective efficacy might also be a result.¹⁰ Policy makers, city planners, and researchers require consistent, reliable data and tools for documenting gentrification to inform the design of healthy cities.

The phenomenon of gentrification is often measured through changes in neighbourhood features, in housing, and in the composition of residents over a period of time. For example, neighbourhood changes are often measured in 10-year intervals, aligning with U.S. census data collection or every two censuses in Canada.¹¹ Quantitative gentrification measures enable reproducibility and facilitate comparisons between cities.¹²

However, no consensus exists on which housing or residential composition factors to include or on what time period is most relevant.¹³ Many researchers rely on a rule-based approach, first detecting gentrifiable or low socioeconomic status areas in a given census and then identifying those that experienced significant change—i.e., were gentrified—in a subsequent census.¹¹

To date, most measures and health impact studies have focused on gentrification in large U.S. cities. For example, two recent reviews on the public health effects of gentrification focused solely on U.S.-based epidemiological studies.^{1,14} The links between gentrification and social determinants of health or health outcomes such as housing instability, food insecurity, collective efficacy, preterm birth, body mass index, hospitalizations and mental health were examined in these studies.^{1,10,14-17} Because of the substantial differences in the historical and sociopolitical contexts between Canada and the United States, there is a need to provide measures of gentrification for Canadian cities. The Gentrification, Urban Interventions, and Equity (GENUINE) tool was developed as a map-based gentrification tool for Canadian cities. The objective of this paper is to present GENUINE and describe gentrification patterns by these measures for all Canadian census metropolitan areas (CMAs) from 2006 to 2016. GENUINE is a set of four gentrification measures that reflect the diversity of approaches to gentrification and the lack of consensus around how to measure it. Insights are also provided on how this tool can be used in population health research and by policy makers.

Table 1
Gentrification measures in the GENTrification, Urban Interventions and Equity (GENUINE) tool for Canadian census metropolitan areas

	Freeman		Ding		Grube-Cavers		Steinmetz-Wood	
	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations
Gentrifiable (2006)								
Spatial areas	Census tracts in central cities in the United States	Census tracts in all Canadian census metropolitan areas (CMAs)	Census tracts with 50+ people and housing units in the United States	Census tracts in all Canadian CMAs	Census tracts in Vancouver, Toronto, Montréal	Census tracts in all Canadian CMAs	Census tracts in Montréal	Census tracts in all Canadian CMAs
Gentrification eligibility criteria	1. Median income below 40th percentile of the metropolitan area	1. Median household income < median for the CMA	Median income below the median for the city	Median household income < median for the CMA	1. Average family income < CMA average	No adaptation	1. Z-score median household income < 0	No adaptation
	2. Proportion of housing built ≤ 20 years was below 40th percentile of the metropolitan area	2. Proportion of housing built since 1990 < median for the CMA	.	.	2. Number of college degree holders per capita < CMA average	No adaptation	2. Z-score university degree holders < 0	No adaptation
	.	.	.	.	.	.	3. Z-score average renting costs < 0	No adaptation
	.	.	.	.	.	.	4. Z-score low-income households < 0	No adaptation
Gentrified (2016)								
Income	.	.	.	.	Increase in family income > CMA average	No adaptation	Z-score difference (from 2006 to 2016) in median household income > 0	No adaptation
Education attainment	Increase in university graduates is greater than that for the metropolitan area	Increase in university degrees > median for the CMA	Increase in university-educated residents above the median for the city	Increase in university degree holders > median for the CMA	Increase in proportion of degrees per capita > CMA average	Increase in proportion of university degree holders > CMA average	Z-score difference in university degree holders > 0	No adaptation
Housing	Increase in real housing prices	Increase in housing value > median for the CMA	Increase in gross rent or median home value above median for the city	Increase in housing value > median for the CMA or increase in renting costs > median for the CMA	1. Increase in average monthly rent > CMA average	No adaptation	Z-score difference in average renting costs > 0	No adaptation
	.	.	.	.	2. Increase in proportion of owner-occupied dwellings > CMA average	No adaptation	.	.
Age	...	...	...	...	...	...	Z-score for proportion of adults aged 30 to 44 > 0	No adaptation
Occupation	...	...	...	...	Increase in proportion of people professional occupations > CMA average	No adaptation	...	...
Poverty	...	...	...	...	...	...	Z-score difference in proportion of low-income households < 0	No adaptation

. not available for any reference period

... not applicable

Note: CMA = Census metropolitan area.

Source: GENTrification, Urban Interventions and Equity (GENUINE) tool.

Data and methods

Study setting

GENUINE was developed to include gentrification measures relevant to the Canadian context by adapting four published gentrification measures that have been applied to U.S. and Canadian census data. These measures were computed for all 36 Canadian CMAs to illustrate where gentrification occurred

between 2006 and 2016. Census tracts—relatively small and stable areas with populations of 2,500 to 8,000 people (average of 4,000)—were used as the unit of analysis.¹⁸ A CMA consists of one or more neighbouring municipalities with a total population of at least 100,000 and where at least 50,000 people live within the core.¹⁹ Geographic boundaries for census tracts are developed by a committee of local stakeholders and Statistics Canada to ensure that they follow permanent physical features and maximize alignment with local neighbourhood

limits when possible.¹⁸ As of 2016, 70.4% of Canadians lived in a CMA.²⁰

Gentrification measures

Two of the gentrification measures adapted for GENUINE were developed in Canada (Grube-Cavers,⁶ Steinmetz-Wood¹⁰) and the other two were developed in the United States (Freeman,²¹ Ding²²). These four measures were chosen because they are well cited in the population health literature. The measures chosen have been used to study the effects of gentrification on general health status,^{23,24} mental health,²⁵ violent crime,²⁶ credit scores,²⁷ collective efficacy,¹⁰ and built-environment features in gentrified areas such as rail transit lines⁶ and bike lanes.²⁸ A summary of the original gentrification measures and the adaptations made to develop GENUINE is presented in Table 1. The original development and rule-based approach for each measure, as well as the approach for GENUINE, is described below.

Freeman (2005) was developed in the United States to examine the association between displacement and gentrification in metropolitan regions across the country.²¹ Gentrification was identified from census data that measured changes during intercensal periods—1980 to 1990 and 1990 to 2000. Census tracts were classified as gentrifiable if the median income was below that of the metropolitan area at the beginning of the intercensal period and the proportion of housing built in the past 20 years was lower than that of the metropolitan area. Gentrifiable census tracts became gentrified if (a) there was a percentage increase in educational attainment greater than that for the metropolitan area and (b) there was an increase in real housing prices over the intercensal period.

Ding (2016) was developed in the United States to study how gentrification in the city of Philadelphia impacted financial health (i.e., credit scores).²⁷ The measure used census data from 2000 and American Community Survey five-year estimates for 2009 to 2013. A census tract was gentrifiable if the median

household income was below that of the city and a gentrifiable census tract was classified as gentrified if (a) the median gross rent or median home value increased more than citywide increases and (b) the proportion of university-educated residents increased more than citywide increases. The Ding measure includes an indicator for gentrification severity. Gentrification is defined as weak (gentrifying tracts where increases in rent or housing values from 2006 to 2016 were equal to or below the 25th percentile), moderate (where rent or housing values increased to between the 25th and 75th percentiles) or intense (where rent or housing values increased to above the 75th percentile).

Grube-Cavers (2015) was developed in Canada to study the relationship between rapid transit infrastructure and gentrification in the CMAs of Vancouver, Toronto and Montréal.⁶ This measure used census data from 1961, 1971, 1981, 1986, 1991, 1996, 2001 and 2006 for Toronto and Montréal and from 1986 onward for Vancouver. A census tract was identified as gentrifiable if (a) the average family income and (b) the percentage of university degree holders were below the average for the CMA. An area was identified as gentrified if, in the next census, all of the following five indicators experienced an increase greater than that of the CMA: average monthly rent, family income, percentage of degree holders, percentage of owner-occupied dwellings and percentage of people in professional occupations.

Steinmetz-Wood (2017) was developed in Canada and used to study the effects of gentrification on neighbourhood collective efficacy in Montréal.¹⁰ This measure was adapted from Grube-Cavers⁶ by replacing the gentrified criteria of the percentage of people in professional occupations with two variables: increases in the percentage of residents aged 30 to 44 and a decrease in the percentage of low-income households. For a census tract to be classified as gentrified, it had to be (a) a gentrifiable area and

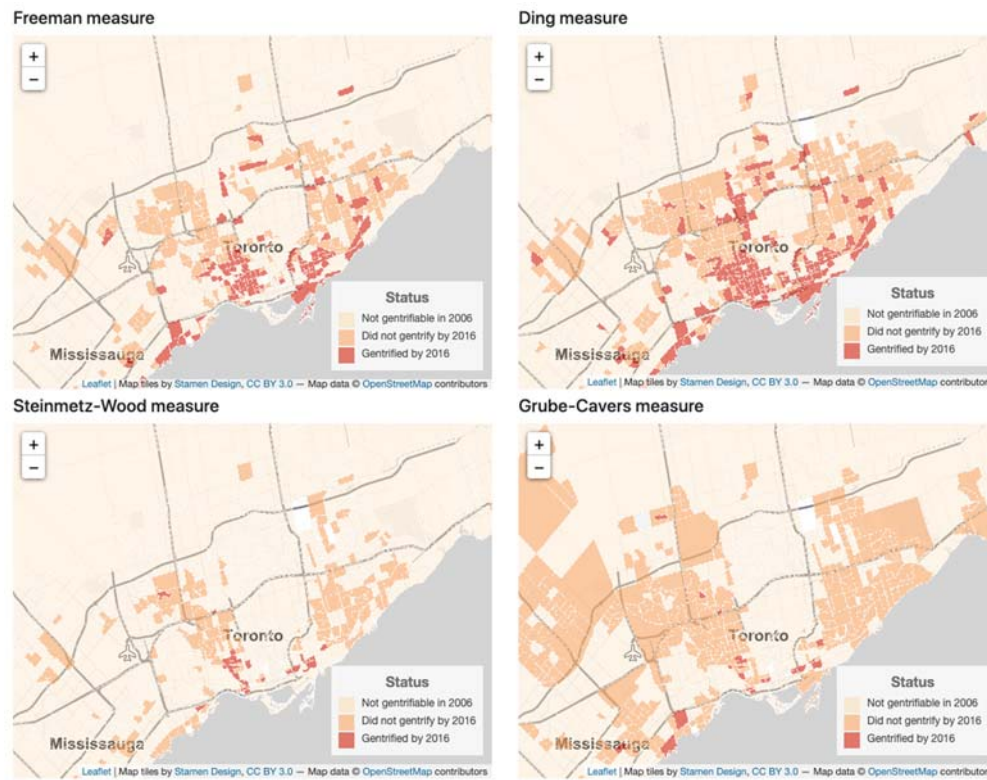
Table 2
Census variables included in gentrification measures for Canadian census metropolitan areas, 2006 and 2016

	2006			2016		
	Median	Minimum	Maximum	Median	Minimum	Maximum
Median household income	56,260	37,862	77,082	72,540	54,624	100,352
Rental housing	25.60	14.30	49.30	27.00	13.50	45.10
Owner-occupied housing	74.40	50.70	85.90	73.00	54.80	86.60
Low-income (LICO) households	7.80	4.60	15.70	5.80	3.90	13.10
Average rental housing price	711	480	927	918	568	1,300
Professional occupation	5.20	3.50	11.60	5.80	3.40	10.40
University degree	19.20	10.60	33.60	21.20	11.40	35.80
Adults aged 30 to 44	21.20	18.00	23.80	19.10	15.90	23.70

Note: LICO stands for low-income cut-off.

Source: Statistics Canada, Census of Population, 2006 and 2016 for all census tracts within census metropolitan areas.

Figure 1
Census tracts that underwent gentrification between 2006 and 2016, Toronto census metropolitan area



Source: GENTrification, Urban INterventions and Equity (GENUINE) tool.

(b), by the next census, experience increases in all five variables (i.e., average monthly rent, family income, percentage of degree holders, percentage of owner-occupied housing and percentage of residents aged 30 to 44) that were greater than increases in the CMA and a decrease in the percentage of low-income households that was greater than that for the CMA. In the original paper, gentrification was measured for 1996 to 2006.

Each measure was adapted for Canadian cities (Table 1) and calculated for 2006 to 2016. Census tract values were compared to a larger geographic area for each measure. For the sake of uniformity, all measures were computed by comparing census tract values to the CMA average (e.g., the median income of a census tract compared to the median income of the CMA). A few minor adaptations to the original measures had to be made, typically relating to adjustments made to account for differences between United States and Canadian data or to account for changes in the availability of census variables. One example is the Freeman measure, which, in the United States, includes the real housing price (i.e., the housing value adjusted for inflation) variable, which does not exist in the Canadian census, so median housing value was used instead.

Statistical methods

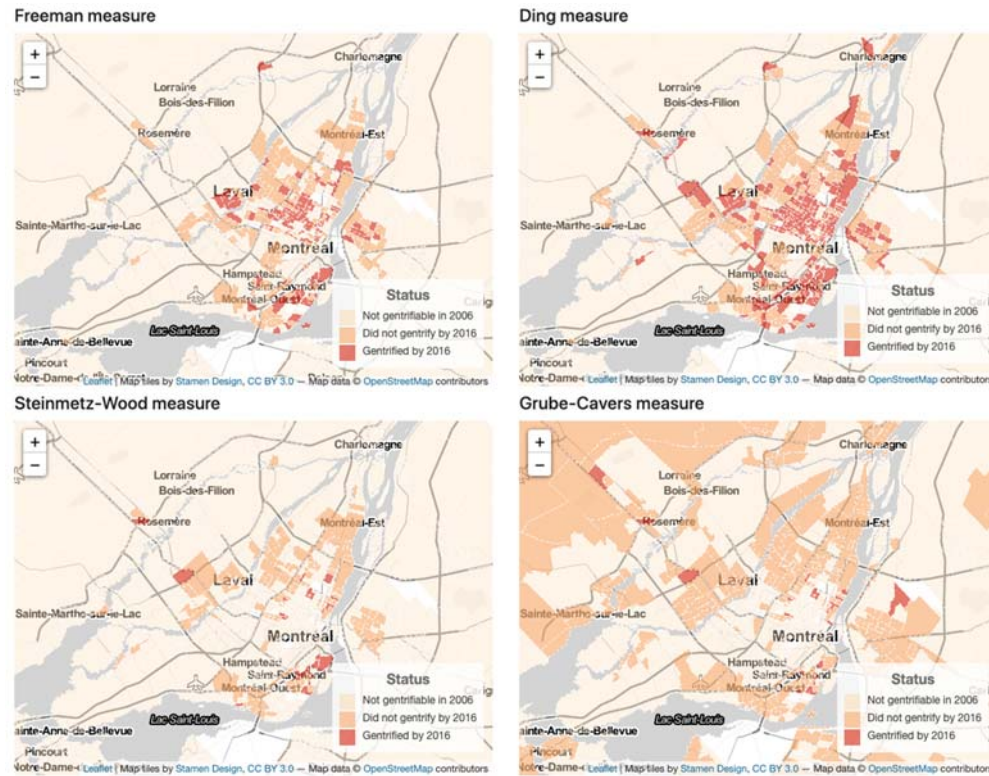
The four gentrification measures were calculated for the period from 2006 to 2016 using Canadian census data. Census data were retrieved from Statistics Canada using the R cencensus

package 0.2.1 for all CMAs at the census tract level for the 2006 and 2016 census years.²⁹ Statistics Canada prioritizes stability in census tract boundaries by providing a conversion table that links dissemination areas—smaller spatial units nested within census tracts—over time.³⁰ Descriptive statistics were calculated for each variable used to measure gentrification in R 3.6.1 and Stata/SE 16.1. Gentrification measures and maps were created in R using the following packages: Hmisc 4.3-1, janitor 1.2.1, cowplot 1.0.0, ggplot2 3.3.0, sf 0.9-4, stringr 1.4.0, tidyr 1.1.0 and dplyr 1.0.0. The corresponding script is available online (https://github.com/TeamINTERACT/GENUINE_paper). The necessary script has been supplied to generate GENUINE measures for other intercensal periods and account for changes in census tract boundaries over time (e.g., the Canadian Longitudinal Census Tract Database, 1971 to 2016).³¹ GENUINE data are published on the Canadian Urban Environmental Health Research Consortium (CANUE) website, and interactive gentrification maps for each CMA can be accessed through the INTERventions, Research and Action in Cities Team (INTERACT) website.

Results

Factors used to measure gentrification are encompassed by domains of income, housing, occupation, education, and age (Table 2). Indicators for housing and residential conditions

Figure 2
Census tracts that underwent gentrification between 2006 and 2016, Montréal census metropolitan area



Source: Gentrification, Urban Interventions and Equity (GENUINE) tool.

varied considerably between CMAs. From 2006 to 2016, median household income and average monthly rent increased more than inflation (e.g., average rent was \$711 in 2006 and \$918 in 2016, representing a 2.6% compound annual growth rate compared to 1.6% for inflation), and the proportion of low-income households declined from 7.8% in 2006 to 5.8% in 2016. By 2016, the median household income across CMAs was \$72,540, with the highest household income in Calgary (\$100,352) and the lowest in Trois-Rivières (\$54,624).

GENUINE data are available through CANUE, and GENUINE maps for all CMAs are published online (https://teaminteract.ca/develop/gentrification/gentrif_test_all_CMA.html). The online maps simultaneously show the four gentrification measures for a given region, highlight the spatial patterning of gentrification and facilitate comparisons between measures. Figures 1 to 4 illustrate GENUINE maps for Toronto, Montréal, Vancouver, and Halifax.

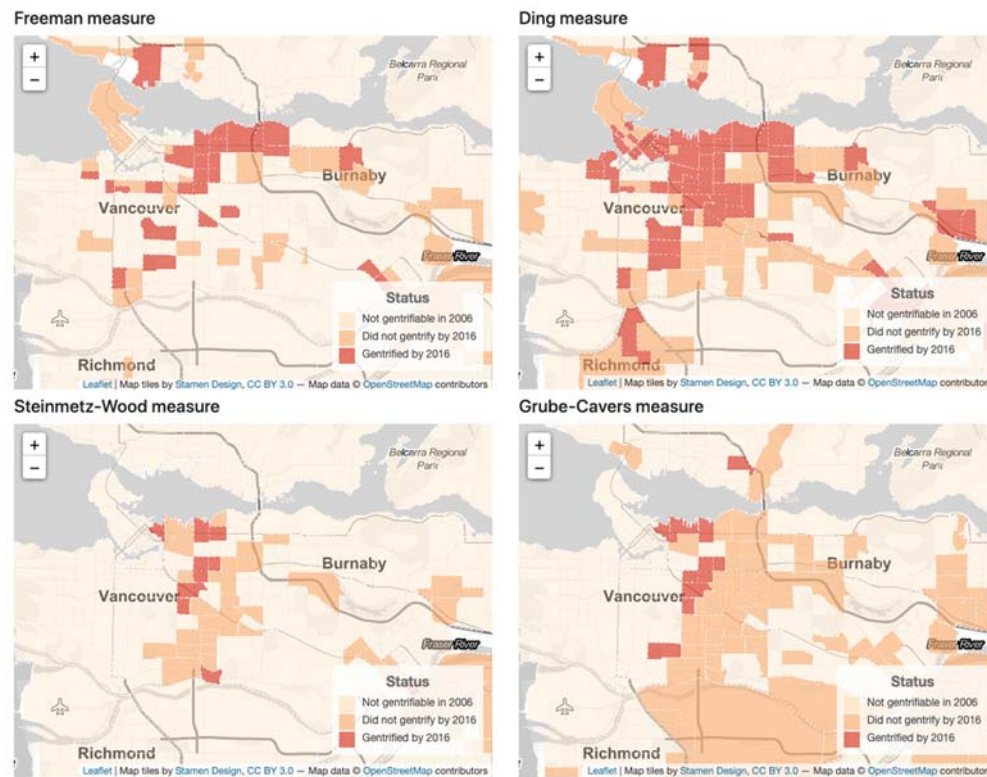
Depending on the measure, in 2006, 18% to 46% of CMA census tracts were considered candidates for gentrification and, by 2016, 2% to 20% of the census tracts were classified as gentrified (tables 3-1 and 3-2). In 2016, this corresponded to between 2% (418,065 people) and 17% (4,266,434) of the Canadian population living in gentrified areas. Generally, CMAs with populations over 1 million have a slightly greater proportion of their population living in gentrified areas (2% to

18%) compared with those with fewer than 250,000 residents (1% to 14%).

By definition, some gentrification measures are more restrictive than others. The Ding measure identified between 40% and 66% of the census tracts of CMAs as gentrifiable, while the Steinmetz-Wood measure identified only between 7% and 25% as gentrifiable, with the two other measures lying somewhere in between. In Toronto, the number of people living in gentrified areas varied up to eightfold depending on the measure, from 123,553 using the Steinmetz-Wood measure to 906,765 using the Ding measure. In some CMAs, Steinmetz-Wood identified no gentrified census tracts at all. For example, in Edmonton, the Steinmetz-Wood measure identified 32 census tracts as candidates for gentrification in 2006, but none experienced enough change to be classified as gentrified in 2016. In contrast, Ding, Freeman and Grube-Cavers identified 65, 43 and 3 census tracts as gentrified over the same time frame, respectively.

The four gentrification measures were poorly correlated with one another. Together, the four measures identified 1,075 unique census tracts as gentrified, yet only 3% (n=32) of these were common across all four measures, and 26 of them were in large CMAs (with over 1 million people). Even when the most restrictive measure (Steinmetz-Wood) is used, only 30% of the 108 census tracts identified as gentrified were also classified as such by the three other—more relaxed—measures. Of all the

Figure 3
Census tracts that underwent gentrification between 2006 and 2016, Vancouver census metropolitan area



Source: GENTrification, Urban INterventions and Equity (GENUINE) tool.

census tracts classified as gentrified by any measure, 6% were identified by three measures, 50% were identified by two measures and 41% were identified by one measure.

Unique insights into the severity of gentrification are provided by the Ding measure. According to these criteria, gentrification was considered weak for 2% of the population living in gentrified areas, moderate for 57% and intense for 41%. Severity indicators are available in the GENUINE dataset on CANUE. Maps of severity are not incorporated into the GENUINE visualization tool currently.

Discussion

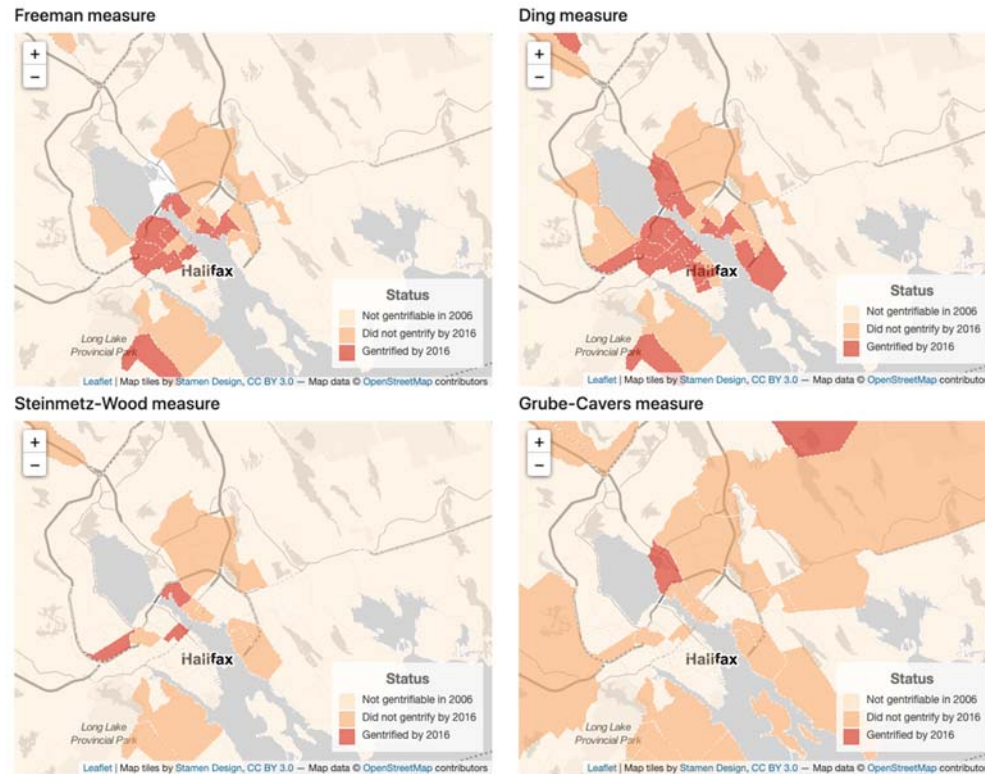
Because there is national interest in advancing solutions-oriented research on healthy cities and major government investment in urban infrastructure and housing affordability,³² unpacking the relationship between gentrification and population health continues to be a central challenge for both research and policy. Cities and policy makers hope to improve neighbourhoods without negative societal and population health consequences that may result from gentrification, such as eroding the neighbourhood culture or displacing residents.³³ In the pursuit of designing resilient cities for all, policy makers and researchers require additional consideration of the policy context,³² as well as local data and tools. The GENUINE tool is an open-access, map-based tool that allows users to explore

measures of gentrification for Canadian cities and incorporate them into their research agendas and healthy city policy development.

Rule-based measures of gentrification, such as the ones provided in GENUINE, are inherently restrictive and focus on a narrow set of comparative characteristics that are potentially inappropriate given the complex, interconnected and contextual nature of urban processes.^{2,34} Other—albeit less common—methods of measuring gentrification use data-reduction techniques (e.g., principal component analysis)^{35,36} or mixed-method approaches (e.g., qualitative methods to groundtruth census-based gentrification measures),¹¹ but these approaches are setting-specific and may not be generalizable to other areas. In addition, by using area-level census measures, researchers are not able to identify specific mechanisms of neighbourhood change. For example, area-level changes in income could result from the in-migration of people with higher incomes and/or out-migration of lower-income earners (e.g., displacement), or it could result from those living in a neighbourhood increasing their income (i.e., people who stayed in the neighbourhood experienced upward social mobility). Despite their limitations, census-based measures are convenient and widely used, and they facilitate comparisons between areas. However, comparing the actual values of the gentrification components used in GENUINE between cities may not be meaningful because of differences in social and economic contexts.

Figure 4

Census tracts that underwent gentrification between 2006 and 2016, Halifax census metropolitan area



Source: Gentrification, Urban Interventions and Equity (GENUINE) tool.

The phenomenon of gentrification manifests differently across cities, and one method of measuring gentrification will likely not capture all forms of the gentrification processes. Therefore, GENUINE users are provided with four gentrification measures, and using one measure over another is not recommended. The implications of using different GENUINE measures to identify gentrified areas in Canada are important and must be considered when using the tool. For example, a study using the Steinmetz-Wood measure to assess the prevalence of gentrification would result in identifying 1/10 of the exposed population compared with a study using the Ding measure. It was found that the number of gentrified census tracts within each CMA was also related to population size—in regions with a population of over 1 million people, a larger proportion of residents lived in gentrified areas compared with smaller regions. Furthermore, only 3% of all census tracts classified as gentrified by any one measure were identified as such consistently across all four measures. These findings are drastic, but they are not unique. Similar discrepancies in gentrification measures have been found in U.S. studies. For example, in the city of Seattle, only one common census tract was identified as gentrified across three distinct measures (58 census tracts were identified by at least one measure).³⁷ Two distinct gentrification measures applied to the San Francisco Bay area showed only 13% agreement in areas identified as gentrified.³⁸ These differences are a challenge for policy makers

and researchers tasked with measuring the extent of gentrification in Canadian communities and its related impacts on health and equity.

Differences observed in the resulting classifications are linked directly to differences in how gentrification is defined for each measure. All measures include components for some change in housing value and educational attainment. However, to identify gentrified areas, both Grube-Cavers and Steinmetz-Wood also require increases in household or family income. Furthermore, Grube-Cavers also requires an increase in the number of people in professional occupations, and Steinmetz-Wood includes reductions in the proportion of low-income residents and increases in the proportion of adults aged 30 to 44. For example, the census tract 8250002.04 in Calgary witnessed a 126% increase in housing value (compared with an average increase of 36% for the CMA) and a 21% increase in the proportion of university degree holders (compared with an average increase of 7% for the CMA). This census tract gentrified according to Ding and Freeman, but not by the Grube-Cavers and Steinmetz-Wood measures, because conditions were not met for family income, people in professional occupations, residents aged 30 to 44 and low-income families. The additional criteria used by the two Canadian-developed measures (Grube-Cavers and Steinmetz-Wood) likely contributed to the low prevalence of gentrification identified across Canada compared with the more relaxed U.S.-developed measures (Freeman and Ding).

For most CMAs, Ding identified the largest number of gentrified areas, followed by Freeman, Grube-Cavers and Steinmetz-Wood. Below is a walk-through of one exception to highlight how local context can influence the results of the gentrification measures. In Vancouver, nearly three times as many people lived in gentrified areas according to the Ding measure compared with the other three measures. It is suspected that the old housing stock criteria for gentrifiable areas in the Freeman measure contributed to the differences observed with Ding. In Vancouver, low-income areas in industrial districts would not be eligible to gentrify using the Freeman method. For example, in advance of the 2010 Winter Olympics, the City of Vancouver converted industrial areas and brownfield sites in southeast False Creek to Olympic Village, which ultimately became high-end condominiums and rental properties. The gentrification of False Creek would not be captured using the Freeman method, as this new multi-unit housing was constructed on former industrial sites, meaning there was no old private-dwelling housing in the area. Therefore, gentrifiable

conditions in the Freeman measure are potentially problematic for areas like Vancouver. The Freeman method does not measure age of housing at the beginning of the gentrification period, so Freeman will not capture gentrification that occurred from the transformation of industrial spaces. Instead, the Freeman measure captures areas that were gentrified from owner-occupied homes being renovated and flipped to make a profit and increase area-level property values.

GENUINE can advance understanding of how place influences health in Canadian cities. Healthy cities researchers require data and tools for identifying neighbourhoods experiencing gentrification to examine how these changes impact health. GENUINE can be linked to existing cohort data, such as Canadian Census Health and Environment Cohorts, to understand how neighbourhood changes influence health. For example, long-term residents who experience gentrification—and a subsequent increase in neighbourhood greenness—may have a decreased likelihood of being depressed. Three

Table 3-1
Gentrification measures by Canadian census metropolitan area, 2006 to 2016 — Part 1

Census metropolitan area (by population)	Number of census tracts number	Proportion of gentrifiable census tracts				Proportion of gentrified census tracts			
		Freeman	Ding	Steinmetz-		Freeman	Ding	Grube-Cavers	Steinmetz-
				Grube-Cavers	Wood				
1,000,000+	3,357	32	45	44	17	11	20	3	2
Toronto	1,145	31	43	45	18	10	16	2	2
Montréal	952	36	48	45	21	14	24	3	3
Vancouver	476	21	42	42	16	6	17	3	2
Calgary	252	34	40	45	12	14	24	3	0
Ottawa–Gatineau	273	33	43	42	16	13	22	3	2
Edmonton	259	37	45	46	12	17	25	1	0
500,000 to 999,999	648	38	47	50	22	14	17	3	3
Québec	180	42	49	51	22	18	24	5	3
Winnipeg	173	31	46	52	22	15	26	3	4
Hamilton	190	42	47	48	22	9	17	3	1
Kitchener–Cambridge–Waterloo	105	32	45	46	23	11	21	2	5
250,000 to 499,999	590	35	46	44	16	8	17	2	1
London	109	38	48	50	17	8	16	2	1
St. Catharines–Niagara	94	33	47	52	19	1	9	1	1
Halifax	95	32	44	44	19	12	20	2	3
Oshawa	84	36	48	36	18	5	17	2	1
Victoria	77	25	42	40	12	10	22	1	1
Windsor	73	42	49	37	11	5	10	1	0
Saskatoon	58	36	41	45	16	19	28	5	2
100,001 to 249,999	697	36	49	45	17	9	17	3	1
Regina	54	30	46	48	22	17	28	0	2
Sherbrooke	48	35	42	33	17	10	17	2	0
St. John's	47	36	49	45	13	15	26	2	0
Barrie	42	31	40	40	7	10	12	2	0
Kelowna	40	33	48	53	25	15	18	5	0
Abbotsford–Mission	39	33	44	36	18	3	8	0	3
Greater Sudbury / Grand Sudbury	44	39	48	48	16	9	14	0	0
Kingston	39	33	51	36	13	10	23	0	0
Saguenay	44	25	41	43	16	2	5	5	0
Trois-Rivières	38	45	50	45	16	8	16	3	0
Guelph	30	37	43	50	17	13	23	0	0
Moncton	29	41	52	52	17	10	21	10	0
Brantford	29	31	45	31	21	3	10	0	3
Saint John	50	48	66	62	22	6	20	2	4
Peterborough	30	37	47	33	10	10	20	10	3
Thunder Bay	36	25	47	47	19	0	14	0	0
Lethbridge	29	38	48	38	10	3	3	3	0
Bellefleur	29	38	41	41	17	3	7	3	0
Grand total	5,292	33	46	45	18	11	20	3	2

Source: GENTrification, Urban Interventions and Equity (GENUINE) tool.

Table 3-2
Gentrification measures by Canadian census metropolitan area, 2006 to 2016 — Part 2

Census metropolitan area (by population)	Total population (2016) number	Proportion of population living in gentrifiable areas				Proportion of population living in gentrified areas			
		Freeman	Ding	Grube-Cavers	Steinmetz- Wood	Freeman	Ding	Grube-Cavers	Steinmetz- Wood
		percent							
1,000,000+	16,528,216	28	41	43	16	9	18	2	2
Toronto	5,928,040	29	42	43	16	8	15	2	2
Montréal	4,098,927	30	42	46	19	10	18	2	2
Vancouver	2,463,431	20	44	43	17	6	18	3	2
Calgary	1,392,609	31	37	44	11	13	22	3	0
Ottawa–Gatineau	1,323,783	28	38	39	14	11	19	3	2
Edmonton	1,321,426	30	36	40	11	13	21	2	0
500,000 to 999,999	2,850,224	31	40	46	19	11	18	3	2
Québec	800,296	30	40	48	17	12	17	6	2
Winnipeg	778,489	27	41	47	19	14	24	3	4
Hamilton	747,545	36	40	43	19	8	14	2	1
Kitchener–Cambridge–Waterloo	523,894	29	39	45	21	9	18	2	4
250,000 to 499,999	2,675,390	30	42	42	14	7	15	3	1
London	494,069	31	41	44	13	7	14	2	1
St. Catharines–Niagara	406,074	32	45	51	18	0	6	2	1
Halifax	403,390	30	42	42	16	11	18	1	3
Oshawa	379,848	31	41	34	15	3	14	2	1
Victoria	367,770	25	43	43	15	10	27	3	3
Windsor	329,144	33	40	33	10	3	6	2	0
Saskatoon	295,095	30	38	47	13	15	26	9	1
100,001 to 249,999	2,891,293	29	40	39	14	8	14	3	1
Regina	236,481	26	41	38	16	15	28	0	2
Sherbrooke	212,105	27	35	28	15	6	15	3	0
St. John's	205,955	28	42	42	11	12	22	2	0
Barrie	197,059	33	41	42	5	10	12	2	0
Kelowna	194,882	26	42	50	18	10	13	5	0
Abbotsford–Mission	180,518	33	41	34	18	4	7	0	1
Greater Sudbury / Grand Sudbury	164,689	33	40	45	15	7	12	0	0
Kingston	161,175	28	37	39	11	11	18	0	0
Saguenay	160,980	24	42	41	11	1	6	5	0
Trois-Rivières	156,042	30	38	38	14	5	11	1	0
Guelph	151,984	28	35	45	12	10	22	0	0
Moncton	144,810	33	41	42	18	12	20	8	0
Brantford	134,203	29	40	28	18	3	7	0	2
Saint John	126,202	31	42	43	14	4	14	1	3
Peterborough	121,721	32	41	29	11	9	21	8	3
Thunder Bay	121,621	22	42	38	14	0	10	0	0
Lethbridge	117,394	32	35	30	8	3	3	7	0
Belleville	103,472	32	38	40	20	4	3	5	0
Grand total	24,945,123	29	41	43	16	9	17	2	2

Source: GENTrification, Urban INterventions and Equity (GENUINE) tool.

conditions are necessary for examining health using existing cohorts: (1) at least 10 years of residential address history that covers the last two census periods; (2) survey data that routinely collect health outcomes or linkage to administrative records; and (3) a sufficient sample size that includes diverse participants in spatially diverse neighbourhoods, making it possible to examine health impacts within different population groups.

GENUINE is a tool for policy action that provides data along with maps so that cities can integrate considerations of gentrification into their policy and program agendas. Insights into where cities should invest resources can be attained by classifying areas that are at risk for gentrification and those that have recently undergone gentrification. For example, green spaces and other built-environment interventions may increase nearby property values and displace low-income residents.

Identifying areas that are at risk for gentrification and intersect new built-environment interventions can inform how city planners implement these interventions to reduce negative impacts on residents. GENUINE data can be integrated into existing city-managed data dashboards to monitor areas that have experienced gentrification. Cities can then prioritize resources for gentrified neighbourhoods through initiatives such as supporting place-based social and health services to mitigate the risk of displacement for low-income residents.

Conclusion

With attention on healthy cities only expanding, GENUINE can be an integral part of solution-oriented research and advancing cities toward designing healthy and equitable communities. Currently, GENUINE is relevant to integrating gentrification into healthy city policy agendas for Canadian cities. The

GENUINE tool will evolve through the longitudinal tracking of gentrification with the upcoming census and the addition of complementary indicators, and this could help identify gentrification-related processes, possible causes and consequences. GENUINE represents an opportunity to facilitate a discussion on and the understanding of gentrification across

Canada, and it can be further linked to built-environment interventions and urban transformations to guide future decision making toward fairer and more equitable cities.

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