



Gentrification, perceptions of neighborhood change, and mental health in Montréal, Québec

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ABSTRACT

While census-defined measures of gentrification are often used in research on gentrification and health, surveys can be used to better understand how residents perceive neighborhood change, and the implications for mental health. Whether or not gentrification affects mental health may depend on the extent to which an individual perceives changes in their neighborhood. Using health and map-based survey data, collected from 2020 to 2021, from the Interventions, Research, and Action in Cities Team, we examined links between perceptions of neighborhood change, census-defined neighborhood gentrification at participant residential addresses, and mental health among 505 adults living in Montréal. After adjusting for age, gender, race, education, and duration at current residence, greater perceived affordability and more positive feelings about neighborhood changes were associated with better mental health, as measured by the mental health component of the short-form health survey. Residents who perceived more change to the social environment had lower mental health scores, after adjusting individual covariates. Census-defined gentrification was not significantly associated with mental health, and perceptions of neighborhood change did not significantly modify the effect of gentrification on mental health. Utilizing survey tools can help researchers understand the role that perceptions of neighborhood change play in the understanding how neighborhood change impacts mental health.

1. Introduction

Gentrified neighborhoods, marked by physical, social, and economic environmental changes (C. L. Firth, Fuller, et al., 2020; Mehdiapanah et al., 2018) can have both positive and negative consequences on health and well-being. Positive impacts may include increased transportation infrastructure, sidewalks, amenities, and jobs for college-educated workers (Freeman, 2005; Hwang & Lin, 2016; Zuk et al., 2018). Negative effects of gentrification can include increased tensions between new and long-term residents, reduced levels of social cohesion, a loss of cultural establishments and small businesses, and an increase in cost of living and housing (Anguelovski, 2015; Curran, 2004; Fullilove & Wallace, 2011; Iyanda & Lu, 2021a; Oscilowicz et al., 2020; Sullivan,

2007). These negative consequences of gentrification are magnified for people facing housing instability, racialized communities, and people whose voices have been historically absent in urban planning processes (Cole et al., 2017; Fullilove & Wallace, 2011; Gibbons, 2019; Tran et al., 2020). The impacts of gentrification may be felt differently by different residents. For example, in a gentrifying neighborhood that is transitioning from majority low-income to majority middle-income, the middle-income residents may benefit more from an increased access to resources, such as groceries and restaurants, while such benefits may be overshadowed by an increasing economic pressure for lower income residents as the cost-of-living increases. These differing experiences of gentrification are evident in the current body of research on gentrification which has shown mixed effects of gentrification on mental health

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(Oscilowicz et al., 2020; Schnake-Mahl et al., 2020; Smith et al., 2020; Steinmetz-Wood et al., 2017).

Susceptibility to and experience of gentrification is dependent on a complex interplay of factors at the individual, intersocial, environmental, and political levels (Rigolon & Németh, 2019), making it challenging to assess the impacts of gentrification on population health (Firth, Fuller, et al., 2020). Gentrification can also contribute to displacement, as people are forced to move due to eviction or rising cost of living or chose to move due to a loss of sense of belonging (Fullilove & Wallace, 2011; Jelks et al., 2021). Health outcomes of displaced residents are often not captured in gentrification research, due to the use of cross-sectional study design and the challenge of following residents as they move. In addition, quantitative studies typically limit measures of gentrification to area-level changes in neighborhood socio-demographic and housing shifts, such as rising property values and increases in household income and educational attainment (Firth, Fuller, et al., 2020). Census-based gentrification measures rely on administrative boundaries to define neighborhoods and assume area-level gentrification aligns with such boundaries. Yet, these do not always align with what residents consider as their neighborhood boundaries. A resident-based assessment might include only a small portion of a census tract or may contain multiple census tracts. Thus, using census tract boundaries to measure neighborhoods may not align with the lived experiences of residents, which in turn, makes it difficult to identify the effects of gentrification on individuals and communities, leaving a continued gap in our understanding of how and why gentrification affects population health (Bhavsar et al., 2020; Coulton et al., 2001). Cross-sectional measures fail to capture the duration of exposure (i.e., how long someone has lived in the neighborhood) to different neighborhood contexts, which has important implications for health (Wodtke et al., 2011). Few studies have examined duration of exposure (or dosage) to gentrification-specific neighborhood factors on health (Agbai, 2021; Izenberg et al., 2018).

Neighborhood environments are also perceived differently by groups of residents, and such perceptions of neighborhood environments may impact health differently or independently of objective measures of neighborhood environment (Curran, 2004; Fullilove & Wallace, 2011; Glass, 1964; Orstad et al., 2017; Zhang et al., 2019). The effect of the neighborhood environment on mental health may depend on the perceived, or subjective neighborhood environment more than the objective neighborhood environment (Zhang et al., 2019). While comparisons of subjective versus objective neighborhood environment's influence on health have been examined in topic areas such as walkability or safety, such comparisons have not been made in the context of gentrification (Wedem et al., 2008; Zhang et al., 2019). Whether or not gentrification affects mental health may depend on the extent to which an individual perceives changes in their neighborhood. Using measures of perceived neighborhood change and perceived gentrification may better capture individuals' experiences of gentrification, and thus help explain how gentrification influences mental health. New survey tools on perceptions and feelings about neighborhood change in the context of gentrification have recently been developed, yet population health researchers have been slow to capitalize and apply these tools or to compare the influence of census-defined measures of gentrification to survey-based measures of gentrification-related change in studies on mental health (Hirsch et al., 2021; Iyanda & Lu, 2021a; Shmool et al., 2015). To address this gap, this paper explores the role of perceived changes to the neighborhood as an effect modifier of the relationships between census-defined gentrification and mental health.

Gentrification extends throughout the Global North and in much of the Global South, as urban revitalization efforts risk the unintended result of displacing lower-income residents in urban areas in many cities in Asia, Australia, Europe, and South America (Atkinson & Bridge, 2004; Guan & Cao, 2020; López-Morales, 2015). Most of the gentrification research in North America focuses on the U.S. context. Gentrification has profoundly impacted many Canadian cities—up to 17% of Canadians

lived in gentrified neighborhoods in 2016 (Firth, Fuller, et al., 2020)—yet research on the impact of gentrification on health in Canadian cities is much more sparse. The process of gentrification is influenced strongly by the social, historical, political, and geographic context. Given the historical and political differences in land use, specific place-based research in Canadian settings can help broaden our understanding of the complex process of gentrification (C. L. Firth, Fuller, et al., 2020; Maloutas, 2012). A handful of studies have linked gentrification in Canadian cities to increases in positive outcomes like more active transportation infrastructure and green spaces (Anguelovski et al., 2022; Flanagan et al., 2016; Grube-Cavers & Patterson, 2015) at the cost of displacing social spaces, such as small grocery stores, increasing tensions between long-term and newer residents in shared public spaces, such as parks, and displacing lower-income residents (Bélanger, 2012; Komakech & Jackson, 2016). Studies on the negative effects of gentrification in Canadian cities have also found a reduction in access to health care services, particularly for vulnerable populations (Goldenberg et al., 2020).

Canadian public health leaders are interested in improving neighborhoods to promote health, while preventing potential negative effects of increased housing costs and displacement (*The Chief Public Health Officer's Report on the State of Public Health in Canada, 2017: Designing Healthy Living*, 2017). A multifaceted approach to untangle the complex relationships between neighborhood change, gentrification, and mental health in Canadian cities is needed to inform public health policy and prevent unintended negative effects of neighborhood revitalization efforts. Using both empirical census-defined measures and survey data to capture resident experiences and perceptions of gentrification, this study provides an exploratory analysis to assess and compare how objective measures of gentrification and measures of perceived neighborhood change are linked to poor mental health among adults living in Canada's second largest city, Montréal. Specifically, the objectives of this study were.

- (1) Assess how subjective, survey-based perceptions of neighborhood change vary across census-defined neighborhood gentrification status.
- (2) Examine the relationship between perceived neighborhood change and adult mental health.
- (3) Examine the relationship between census-defined gentrification, and adult mental health, and whether duration of living in, or close to, a gentrified neighborhood is important for mental health.
- (4) Assess the role of perceived neighborhood change in modifying the association between census-defined gentrification and mental health.

2. Methods

This research is embedded within the INTERventions, Research, and Action in Cities Team (INTERACT) study, a pan-Canadian research program assessing the health and equity impacts of built environment interventions across Canadian cities (Fuller et al., 2021; Kestens et al., 2019). We used survey data collected September 2020 to February 2021 from INTERACT participants, adults living in Montréal who completed both an online health survey and provided residential address histories back to 2006, collected through a map-based survey tool VERITAS (Chaix et al., 2012; Naud et al., 2020).

The city of Montréal is located in the province of Québec, Canada with a metropolitan area population of 4.3 million people as of 2021, making it the second most populous city in Canada. The metropolitan area of Montréal has a median age of 40.8 years and a household median income of \$63,600 (CAD; Government of Canada, 2022). The majority of residents live in an apartment or flat (60%) and nearly half are renters (46%). In 2006 in Montreal, 42% of residents lived in census tracts that were considered gentrifiable (i.e., having the capacity to gentrify), and

as of 2016, 18% of the metro area population lived in a census tracts that gentrified between 2006 and 2016 (Firth et al., 2021).

Gentrification discourse in Montreal has largely focused on specific neighborhoods where public and private investments in historically working-class neighborhoods have exacerbated gentrification processes. Reinvestment projects, such as the revitalization of the Lachine Canal in the 1990s, has had profound impacts on housing costs in the Sud-Ouest and nearby Parc-Ex neighborhoods (Maltais & Bélanger, 2021). Quebec, Montréal's province, has had historically lower homeowner rates than elsewhere in Canada. The province has strong renter protection policies, such as rent control, which governs the amount landlords can increase rents (Government of Canada S.C, 2022b, September 21). Yet, renters face increasing rental housing shortages. In 2022, Montreal's vacancy rate fell to 2.3% (Press, 2023), due in part to a return of international students and a slower transition to homeownership linked to a strong increase in house prices during the pandemic (Rental Market Report, 2023). More recently, gentrification has been in part driven by the relocation of international organizations to Montréal through incentivization of international investments, and a strong governmental support of the tech and start-up ecosystem (Moser et al., 2019), among other reasons.

Participant recruitment for the INTERACT study primarily included social media campaigns and communication through partner organizations. Surveys were completed online, with an option to complete them over the phone or through a video chat. All participants were at least 18 years old at the time of data collection, lived in Montréal, and were able to read and write in French or English. The majority of the surveys (84%) were completed in French, with the remaining 16% completed in English. The Montréal cohort of the INTERVENTIONS study was not representative of the general population. Participants tended to be higher income and female, and underrepresented people of color. Additional details on participant recruitment and inclusion has previously been published (Fuller et al., 2021).

2.1. Gentrification exposure measures

2.1.1. Perceptions of gentrification

We adapted the Perceptions about change in environments and residents (PACER) tool for INTERACT (Hirsch et al., 2021). The PACER tool focuses on perceptions of change in one's neighborhood and the degree to which change has been happening over the past three to five years, or the way it is currently changing; a PACER tool validation study was completed in Philadelphia, Pennsylvania (Hirsch et al., 2021). The tool contains questions on the types of neighborhood change (response options: not happening, happening a little, happening a lot, I don't know) and feelings about change (response options: 5-point Likert scale from strongly agree to strongly disagree) which have been collapsed into four composite measures: (1) changes to the built environment (new businesses, turnover in businesses, expensive grocery stores, new buildings, new or improved resources), (2) changes to the social environment (neighborhood personality, new residents, flipping properties, neighborhood conflict), (3) changes in affordability (afford to move, fear of being pushed out of the neighborhood, cost of housing increased), and (4) feelings about the changes in the neighborhood (feel welcome, trust new residents, feel good about changes, support changes). Higher scores in changes to the built and social environment measures corresponded with greater perceived change, higher values for affordability corresponded with greater perceived affordability of one's neighborhood, and a higher value for feelings about changes indicated more positive feelings. In addition to the four composite measures, we included three measures from the PACER tool that ask residents about the degree to which they believe their neighborhood has gentrified, the amount of change that has occurred in the past 3–5 years, and the speed at which changes have occurred (scale of 1–10).

For comparison purposes, we transformed the seven PACER measures into quartiles for multivariable analysis so each measure was on

the same scale and model coefficients could be interpreted as the effect of a one-quartile difference on the outcome. Internal consistency and dimensionality of the PACER composite measures was verified using Cronbach's alpha and correlation coefficients and compared to those derived in the Philadelphia-based validation analysis by Hirsch et al. (Hirsch et al., 2021); see Supplemental Table A1). In multivariable analysis, each of the seven PACER measures were separately analyzed to assess their association with mental health (Objective 2). PACER measures were collapsed into two categories (below median, at or above median), and each was assessed as an effect modifier of gentrification on mental health (Objective 4).

2.1.2. Census-defined gentrification

We calculated neighborhood gentrification based on changes in census characteristics (referred to as "census-defined gentrification" throughout this manuscript) and amount of time living in or near (within 250-m) a gentrified neighborhood for each participant using Statistics Canada census data. Census tracts (CT) are areas that represent on average where 2500 to 7500 people live (Government of Canada S. C, 2017) and were used to approximate neighborhoods. Neighborhood gentrification measure relied on the Gentrification, Urban Interventions, and Equity (GENUINE) tool, an open access mapping tool that measures CT-level gentrification across Canadian cities using 2006, 2011, and 2016 Canadian census (C. L. Firth et al., 2021; see Supplemental Figures). Neighborhood gentrification was determined from a two-step process and measured in 5-year increments to align with the Canadian census. First, a CT was a candidate for gentrification, or gentrifiable, if the median household income for the first census year (2006 or 2011) was lower than that of the census metropolitan area (CMA). Second, a CT was determined to have gentrified by the next census if the increases in residents with at least a bachelor's degree and home value or rent was greater than the increases for the CMA. Areas that did not gentrify included CTs with a median household income equivalent to or higher than the CMA during 2006 and 2011 as well as CTs that were gentrifiable but did not see an increase in residents with at least a bachelor's degree and a home value or rent increase that was greater than the increase for the CMA. Each CT could be classified as having (1) not gentrified between 2006 and 2016, (2) less recent gentrification, between 2006 and 2011, (3) more recent gentrification, between 2011 and 2016, or (4) sustained gentrification, gentrification that occurred from 2006 to 2016.

For each participant, we geocoded their residential addresses and spatially joined to CTs to calculate gentrification status of their current neighborhood and distance to nearest gentrified neighborhood, by calculating Euclidean distances between CT centroids, to determine the duration of time (in months) each participant spent living in gentrified neighborhoods since 2006 and the duration of time (in months) living in a neighborhood that was within 250 m of a gentrified neighborhood. Prior survey-based gentrification studies have rarely included complete residential histories within their survey instruments. Often, a dichotomized measure simply distinguishes long-term from newer residents (Hyrá et al., 2019). Our residential history data allows us to derive more specific measures of cumulative exposure to gentrification in order to examine whether longer duration of exposure to gentrification is associated with mental health, similar to a recent approach used by Agbai (2021). We chose to scale the duration measures into four categories: 0 months and three groups based on tertiles (duration in gentrified neighborhood tertiles: 1–59 months, 60–95 months, 96 or more months; duration in 250-m buffer tertiles: 1–34 months, 35–60 months, and 61 or more months). Duration in a gentrified neighborhood and duration near a gentrified neighborhood were separately analyzed to assess their association with mental health.

2.2. Mental health outcome measures

We used the short-form 12 (sf-12) health survey to measure mental

health. The mental health component of the sf-12 encompasses domains of Vitality (energy and fatigue), Social Functioning (limitations in social activities because of physical or emotional problems), Role-Emotional (limitations in usual role activities because of emotional problems), and Mental Health (psychological distress and wellbeing; Ware et al., 2002). We calculated an overall mental health score for each participant, using previously validated weights (Ware et al., 1995). A higher score on the sf-12 mental health component indicates better mental health, with potential scores ranging from 0 to 100. We used the overall mental health composite score as our primary outcome.

2.3. Covariates

We included participant demographic characteristics that may confound the associations between neighborhood changes and mental health as covariates in our models. Prior research has shown that age, gender, race/ethnicity, and education level may influence perceptions of neighborhood change and that there exists differences in mental health levels based on these characteristics (Bassett & Moore, 2013; Cole et al., 2019; Pun et al., 2018; Smith et al., 2020; Stafford et al., 2005). As such, we adjusted for each of these confounding characteristics in our multivariable analysis. We used age group (<30 years old, 30–49 years old, 50–64 years old, and 65 years and older); gender (woman, man, or non-binary/trans); and due to the small proportion of respondents who were people of color (5.1% Multiracial, 3.2% Asian, 1.2% Hispanic/Latino, 1.2% Middle Eastern, 1% Black, and 1.4% Other), we dichotomized race (white people, people of color). In addition, we adjusted for duration of residency, or the number of months participant had lived in their current home at the time of data collection.

2.4. Statistical analysis

We described our participant sample and conducted descriptive analyses, comparing participant demographics by census-defined gentrification categories (no gentrification 2006–2016, less recent gentrification 2006–2011, recent gentrification 2011–2016, and sustained gentrification 2006–2016). We used one-way ANOVA tests to examine patterns of perceived neighborhood change across census-defined measures, and to better understand and to assess whether the degree of perceived change varies with the timing of gentrification (recently, less recently, or sustained).

To assess whether perceptions of neighborhood change are predictive of mental health on their own, we conducted a series of multivariable linear regression models to examine the association between each PACER measure and mental health, conducting a separate linear model for each of the seven measures of perceived neighborhood change: built environment change, social environment change, perceived affordability, feelings about change, perceived gentrification, speed of neighborhood change, and amount of neighborhood change. The first series of models did not adjust for participant characteristics (Series 1: Unadjusted Models) and in the second series, we adjusted for education, gender, age, race/ethnicity, and duration at current residence in each model (Series 2: Adjusted Models).

We also examined whether living in a census-defined gentrified neighborhood was associated with mental health. We examined census-defined gentrification measures and their relationship with mental health, including the categorical measure of gentrification timing (no gentrification [reference], less recent, recent, sustained), quantiles of the number of months living in a gentrified neighborhood, and quantiles of number of months living within 250 m of a gentrified neighborhood. We again repeated our two series of models—Series 1: Unadjusted models and Series 2: Adjusted models.

In our final series of models (Series 3), we examined whether PACER measures modified the association between census-defined gentrification and mental health. In these models, we coded each PACER measure for the effect modification analysis as a two-level categorical variable (0:

less than or equal to the median value, 1: above the median value). We assessed whether perceptions of social and built environment change (more versus less perceived change), perceived affordability (more versus less perceived affordability), feelings about change (more positive versus less positive), perceived gentrification (More versus less perceived gentrification), speed of change (faster versus slower change) or amount of change (more versus less perceived change) modified the association between living in a census-defined gentrified neighborhood and mental health. We conducted separate models for each PACER measure of perceived change and examined the interaction of perceived change with census-defined categorical measure of gentrification (no gentrification [reference], less recent gentrification, recent gentrification, sustained gentrification). In each of these models, we adjusted for all participant covariates. All analyses were conducted using R Studio (RStudio Team, 2020).

3. Results

Of the 601 adults living in Montréal who completed health surveys between September 2020 to February 2021, 6 were missing covariate data and 90 did not provide residential address histories, leaving a final analytic sample of 505 respondents. Most respondents were women (64%), white (86%), had at least a bachelor's degree (80%), and 42% had an annual household income of \$100,000 (CAD) or more (Table 1). There was minimal clustering of survey respondents within census tracts, as our sample included individuals across 300 census tracts within Montréal, with at most 6 participants living within the same tract.

Comparing participants by their census-defined neighborhood gentrification category, proportionally, more men and non-binary adults lived in gentrified neighborhoods than women (Table 1). Residents of neighborhoods with less recent gentrification had lower incomes, lower education levels, and were more likely to be people of color, compared with residents who lived in neighborhoods with more recent gentrification or neighborhoods that did not gentrify between 2006 and 2016. Additionally, residents in gentrified neighborhoods of any type were more likely to be under the age of 50 and had lived in their neighborhood, on average, almost 4 years less than residents of neighborhoods that did not gentrify (Table 1).

Patterns emerged when comparing perception-based measures to census-defined gentrification categories (Table 2). Residents living in neighborhoods with sustained gentrification (from 2006 to 2016) reported more neighborhood change, at a faster pace, and perceived more gentrification in their neighborhood than participants living in neighborhoods with less exposure to gentrification. Perceptions of change in the built and social environment were also significantly different across the census-defined levels of gentrification, with the highest levels of change perceived among those living in neighborhoods with sustained gentrification, and the lowest level of change perceived by those residing in neighborhoods that had not gentrified. Feelings about neighborhood changes and perceived affordability did not vary significantly by neighborhood gentrification category, although residents in neighborhoods with sustained gentrification and recent gentrification appeared to report somewhat lower levels of perceived affordability compared to residents in neighborhoods with no gentrification.

3.1. Gentrification and mental health

From multivariable models examining perceived change, we found that neighborhood affordability and positive feelings about neighborhood change were each associated with higher mental health, after controlling for education, gender, age, race, and months at current residence (see Table 3). Perceived change to the social environment and perceived gentrification were negatively associated with mental health, although the association between perceived gentrification and mental health was not significant after adjusting for covariates. Perceived built

Table 1
Participant demographics by census-defined neighborhood gentrification categories.

Characteristic	Overall, N = 505 ^a	Census-defined neighborhood gentrification categories			
		No Gentrification, n = 171	Less Recent 2006–2011, n = 109	Recent 2011–2016, n = 84	Sustained 2006–2016, n = 141
Gender					
man	169 (33%)	58 (34%)	35 (32%)	24 (29%)	52 (37%)
woman	324 (64%)	111 (65%)	71 (65%)	58 (69%)	84 (60%)
non-binary/trans/other	12 (2.4%)	2 (1.2%)	3 (2.8%)	2 (2.4%)	5 (3.5%)
Age					
<30 years	62 (12%)	24 (14%)	16 (15%)	9 (11%)	13 (9.2%)
30–49 years	205 (41%)	52 (30%)	41 (38%)	43 (51%)	69 (49%)
50–64 years	152 (30%)	55 (32%)	35 (32%)	15 (18%)	47 (33%)
65+ years	86 (17%)	40 (23%)	17 (16%)	17 (20%)	12 (8.5%)
White	434 (86%)	150 (88%)	88 (81%)	73 (87%)	123 (87%)
Education level					
Bachelors or higher	406 (80%)	136 (80%)	81 (74%)	75 (89%)	114 (81%)
Less than Bachelors	99 (20%)	35 (20%)	28 (26%)	9 (11%)	27 (19%)
Annual household income					
<\$100,000	266 (58%)	88 (59%)	64 (65%)	47 (59%)	67 (52%)
\$100,000 or more	190 (42%)	61 (41%)	34 (35%)	33 (41%)	62 (48%)
Missing	49	22	11	4	12
Total months living in current residence					
Mean (SD)	112 (120)	142 (130)	97 (113)	97 (107)	97 (114)
Mental health					
Mean (SD)	46 (11)	46 (12)	47 (11)	46 (11)	45 (11)

^a n (%); “Mean (SD)”.

Table 2
Measures of perceived neighborhood change by census-defined gentrification categories among adults living in Montréal.

Perceived neighborhood change measure ^c	Overall, N = 505 ^a	No Gentrification, n = 171	Less Recent 2006–2011, n = 109	Recent 2011–2016, n = 84	Sustained 2006–2016, n = 141	p-value ^b
Amount of change	6.03 (2.08)	5.39 (2.18)	5.90 (2.11)	5.92 (1.75)	6.96 (1.80)	<0.001
Speed of change	5.82 (2.13)	5.16 (2.17)	5.93 (2.36)	5.85 (1.95)	6.53 (1.75)	<0.001
Perceived gentrification	6.21 (2.84)	4.98 (2.88)	6.22 (2.81)	6.27 (2.75)	7.65 (2.08)	<0.001
Change in social environment	0.21 (0.60)	0.08 (0.55)	0.20 (0.64)	0.25 (0.58)	0.34 (0.60)	0.002
Change in built environment	0.68 (0.63)	0.49 (0.64)	0.59 (0.59)	0.66 (0.65)	0.98 (0.52)	<0.001
Feelings towards changes	0.68 (0.68)	0.64 (0.60)	0.70 (0.68)	0.66 (0.71)	0.71 (0.76)	0.8
Affordability	0.11 (0.81)	0.21 (0.74)	0.12 (0.91)	0.04 (0.76)	0.02 (0.85)	0.2

^a “Mean (SD)”.

^b One-way ANOVA test.

^c Amount of Change, speed of change, and perceived gentrification were assessed on a 1 to 10 scale, and the four remaining measures (Change in social environment, change in built environment, feelings towards change, and affordability) are composite scores with a range in values from –2 to 2.

Table 3
Linear Regression Analyses: Mental health as a function of perceived neighborhood change.

Model	Perceived Change Models – main predictor	Series 1 - Unadjusted model				Series 2 - Adjusted models ^a			
		β	95% CI	p-value	β	95% CI	p-value		
Model 1	Built environment change	–0.38	–1.30 0.54	0.42	–0.24	–1.12 0.64	0.59		
Model 2	Social environment change	–1.07	–2.00 –0.14	0.02*	–0.96	–1.86 –0.07	0.04**		
Model 3	More affordable	1.45	0.59 2.30	0.001*	1.28	0.47 2.10	0.002**		
Model 4	Positive feelings about change	0.66	–0.26 1.58	0.16	1.54	0.64 2.44	0.001***		
Model 5	Perceived gentrification	–1.42	–2.29 –0.54	0.002*	–0.78	–1.64 0.09	0.08*		
Model 6	Amount of change	–0.37	–1.18 0.45	0.37	–0.17	–0.95 0.61	0.67		
Model 7	Pace of change	–0.26	–1.15 0.62	0.56	–0.08	–0.93 0.76	0.85		

Note: β is beta coefficients and each β indicates a separate regression model.

*p < 0.10, **p < 0.05, ***p < 0.001.

^a Covariates include age (reference = < 30 years old), gender (reference = man), race (ref = white), education level (reference = bachelor’s and higher), and months at current residence (continuous).

environment change, amount of change and pace of change were not associated with mental health.

We ran similar models using census-defined measures of gentrification, rather than perceptions (Table 4). Living in a neighborhood with any level of census-defined gentrification was not significantly associated with mental health. Number of months living in or near (within 250-m) a gentrified neighborhood was not significantly associated with

mental health.

3.2. Interaction of perceived and census-defined measures of neighborhood change

Table 5 shows the results from the final series of linear regression models, in which we assessed whether the impact of gentrification on

Table 4
Linear Regression Analyses: Mental health as a function of census-defined gentrification.

Model	Objective Change Models – main predictor	Series 1 - Unadjusted models			Series 2 - Adjusted models ^a				
		β	95% CI	p-value	β	95% CI	p-value		
Model 8	Gentrified								
	Less recent 2006–2011	0.99	–1.69	3.67	0.47	2.16	–0.13	4.96	0.10*
	Recent 2011–2016	0.02	–2.90	2.93	0.99	1.30	–1.40	4.14	0.36
	Sustained 2006–2016	–0.93	–3.41	1.56	0.47	0.29	–2.06	2.71	0.81
Model 9	Duration living in gentrified neighborhood ^b	–0.64	–1.50	0.23	0.15	–0.57	–1.42	0.29	0.19
Model 10	Duration living near gentrified neighborhood ^c	–0.35	–1.21	0.52	0.43	–0.56	–1.39	0.28	0.19

Note: β is beta coefficients and each β indicates a separate regression model.

* $p < 0.10$ level.

^a Covariates include age (reference = < 30 years old), gender (reference = man), race (ref = white), education level (reference = bachelor's and higher), and months at current residence (continuous).

^b Number of months (in quartiles) living in a gentrified neighborhood.

^c Number of months (in quartiles) living within 250-m of gentrified neighborhood.

mental health varied by perceived level of neighborhood change. There were some categories of census-defined gentrification that had a stronger effect on mental health depending on the level of perceived neighborhood change. For example, the mean mental health score for residents in neighborhoods with sustained gentrification who had more positive feelings about change was 5.5 points higher than residents living in neighborhoods with no gentrification and less positive feelings towards change. However, based on a likelihood ratio test of the interactions, none of the PACER measures significantly modified the association between census-defined gentrification and mental health.

A full summary of the results and implications of the results are shown in Table 6.

4. Discussion

According to prior research, as many as 17% of Canadians lived in census-defined gentrified neighborhoods in 2016 (Firth, Fuller, et al., 2020). Given these levels of exposure to gentrification along with the continued investment in neighborhood infrastructure that may lead to more gentrification in coming decades, it is vital to build a better understanding of how neighborhood gentrification can impact mental health. Gentrification is a complex interplay of social, political, and built environment factors, that are perceived and experienced differently by different groups of residents (Bhavsar et al., 2020; Sullivan, 2007; Tulier et al., 2019). Our study considers the multiple aspects of perceived neighborhood change alongside census-defined measures of gentrification and examines the impact each of these aspects have on mental health.

Perceived affordability and feelings about neighborhood changes were associated with mental health in our sample but did not significantly modify the association between gentrification and mental health. Residents in gentrifying neighborhoods, particularly lower-income residents, may experience increasing levels of economic stress as higher housing costs creates a strain on their budget and pressure to relocate (Shmool et al., 2015). However, this effect of housing affordability on mental health extends beyond the context of gentrification (Baker et al., 2020; Bentley et al., 2011), which may be why we did not observe a significant interaction between perceived affordability and census-defined gentrification in this sample. Furthermore, our sample had higher incomes than the general population of Montréal (42% of our sample, compared to 8.3% of Montréal residents had incomes greater than \$100,000 in 2020; Government of Canada S.C., 2022a). Therefore, our study likely did not fully capture the perceptions of unaffordability among residents with lower incomes who may be more affected by housing costs. While increasing housing costs create a risk of physical displacement, gentrification can also lead to changing norms and feel of a neighborhood, which can result in cultural displacement (Iyanda & Lu, 2021b; Shaw & Hagemans, 2015). Residents experiencing cultural displacement due to gentrification are more likely to have less positive

feelings about changes in their neighborhood as their sense of belonging erodes, leading to increased levels of stress and anxiety (Shaw & Hagemans, 2015; Sullivan, 2007; Versey et al., 2019). This study provides evidence of an association of perceived affordability and feelings about change on mental health, both of which are important factors in gentrifying neighborhoods.

Perceived change to the social environment was also significantly associated with mental health, with more perceived change to the social environment associated with worse mental health. This association is supported by prior research showing a negative effect of gentrification on mental health through the loss of community and through an increase in social tensions with neighbors (Iyanda & Lu, 2021a, 2021b; Shmool et al., 2015). This tension can increase psychosocial stress among residents and result in a decline in mental health, particularly for longer-term residents and residents of color (Betancur, 2011; Mehdipanah et al., 2018). While greater perceived social environment change was reported by residents of neighborhoods that had sustained gentrification compared to residents of neighborhoods with no gentrification, perceived social environment change did not significantly modify the association of census-defined gentrification and mental health.

Looking at the independent effects of census-defined measures of gentrification, we found no correlation between living in a gentrified neighborhood and overall mental health. When stratified by level of perceived change, the relationship between census-defined gentrification and mental health did not significantly vary, thus we failed to find a significant modifying effect of perceived neighborhood change on the relationship between census-defined gentrification and mental health. Our finding contrasts prior research that has shown detrimental effects of gentrification on mental health (Betancur, 2011; Gibbons, 2019; Mehdipanah et al., 2018; Tran et al., 2020). Other studies have found null or even positive associations between gentrification and mental health, particularly for higher income residents (Mair et al., 2015; McCartney et al., 2017; Steinmetz-Wood et al., 2017). Our sample was predominantly white, higher-income residents, and we lacked the power to assess the potential modifying effects of income or race in this study.

In addition, we examined the influence of duration living in a gentrified neighborhood, as measures of duration of exposure, often called dosage, are very common in epidemiology studies and in studies on neighborhood context and health. While prior research has shown some evidence that health is associated with duration of exposure to gentrification (Agbai, 2021), we did not find evidence of a dosage effect of exposure to gentrification in this study. Residential history data also allowed us to look specifically at the duration of exposure to areas adjacent to gentrified census tracts where gentrification effects may cross census tract boundaries. Prior research has shown that tracts adjacent to gentrifying tracts may also experience increasing housing costs (Wilhelmsson et al., 2021) and increased income inequality (Christafore & Leguizamon, 2019). In our sample, the duration of time living within 250-m of a gentrified neighborhood was not significantly

Table 5
Results of multivariable linear regression coefficients models that assess whether perceptions of neighborhood change modified the links between census-defined gentrification and adult mental health.

Effect modification models and primary predictors	Series 3 – Effect Modification Models			LRT p-value ^b
	β	95% CI		
Social Factor Interaction Model^a				0.22
Gentrification: Less recent*Social Environment (Ref = less change * no gentrification)	-2.85	-8.11 2.41		
Gentrification: Recent*Social Environment (Ref = less change * no gentrification)	2.72	-2.98 8.41		
Gentrification: Sustained*Social Environment (Ref = less change * no gentrification)	-2.56	-7.41 2.30		
Built Environment Interaction Model^a				0.26
Gentrification: Less recent*Built Environment (Ref = less change * no gentrification)	0.74	-4.56 6.03		
Gentrification: Recent*Built Environment (Ref = less change * no gentrification)	5.91	0.14 11.69		
Gentrification: Sustained*Built Environment (Ref = less change * no gentrification)	3.56	-1.37 8.48		
Affordability Interaction Model^a				0.75
Gentrification: Less recent*Affordability (Ref = less affordable * no gentrification)	0.34	-3.10 3.78		
Gentrification: Recent*Affordability (Ref = less affordable * no gentrification)	-0.44	-3.40 2.51		
Gentrification: Sustained*Affordability (Ref = less affordable * no gentrification)	2.19	-2.75 7.12		
Feelings Interaction Model^a				0.14
Gentrification: Less recent*Feelings about change (Ref = less positive feelings * no gentrification)	1.44	-3.76 6.63		
Gentrification: Recent*Feelings about change (Ref = less positive feelings * no gentrification)	3.19	-2.47 8.85		
Gentrification: Sustained*Feelings about change (Ref = less positive feelings * no gentrification)	5.46	0.69 10.24		
Perceived Gentrification Interaction Model^a				0.14
Gentrification: Less recent*Perceived gentrification (Ref = less gentrification * no gentrification)	1.61	-3.99 7.22		
Gentrification: Recent*Perceived gentrification (Ref = less gentrification * no gentrification)	6.90	0.77 13.02		
Gentrification: Sustained*Perceived gentrification (Ref = less gentrification * no gentrification)	1.10	-4.18 6.37		
Amount of Change Interaction Model^a				0.53
Gentrification: Less recent*Amount of change (Ref = less change * no gentrification)	1.52	-3.79 6.84		
Gentrification: Recent*Amount of change (Ref = less change * no gentrification)	4.04	-1.74 9.82		
Gentrification: Sustained*Amount of change (Ref = less change * no gentrification)	2.64	-2.37 7.66		
Speed of change Interaction Model^a				0.17
Gentrification: Less recent*Speed of change (Ref = slower change * no gentrification)	0.74	-4.56 6.03		
Gentrification: Recent*Speed of change (Ref = slower change * no gentrification)	5.91	0.14 11.69		
Gentrification: Sustained*Speed of change (Ref = slower change * no gentrification)	3.56	-1.37 8.48		

*p < 0.10; **p < 0.5.

^a Covariates include age (reference = < 30 years old), gender (reference = man), race (ref = white), education level (reference = bachelor's and higher), and months at current residence (continuous).

^b Likelihood Ratio Test of the interaction effect.

associated with mental health.

5. Strengths, Limitations, and Opportunities

Our research had several important strengths, including the use of categorical census-defined measures of gentrification, and the use of both survey-based and census-defined measures of gentrification to provide a more complete picture of the association of gentrification and mental health. The majority of research on gentrification and health often utilizes census-defined measures of gentrification (Firth, Fuller, et al., 2020) and dichotomous categories of gentrification (Smith et al., 2020). These measures do not account for varying paces and categories of gentrification (Ding et al., 2016), which can significantly affect displacement stress (Freeman & Braconi, 2004) and ultimately influence mental health outcomes associated with gentrification. Using 4 levels of gentrification (no gentrification [reference], less recent gentrification, recent gentrification, and sustained gentrification) allowed us to assess how perceptions of gentrification and mental health vary by category of gentrification, providing a more nuanced examination of resident experiences of gentrification, and demonstrating the differing levels of perceived change associated with the different categories of gentrification.

Survey-based measures of neighborhood change also play an important role in understanding how neighborhoods and gentrification influence health (Hirsch et al., 2021; Weden et al., 2008), and is particularly important in the context of mental health, which may more affected by subjective measures of the neighborhood environment (Zhang et al., 2019). In our models looking across the categories of census-defined gentrification and resident perceptions of neighborhood change, there were strong correlations between perceptions of neighborhood change and the category of gentrification. For example, residents in areas with sustained gentrification and presumably more neighborhood changes also perceived the most changes. Residents of gentrified neighborhoods were more likely to report higher levels of perceived gentrification, change to the social environment, change to the built environment, faster paced change and more overall change. The survey-based measures also captured both (1) individuals who live within gentrified neighborhoods, but did not notice significant changes, and (2) individuals who live outside of gentrified neighborhoods but noticed changes in their environments. These subjective measures of neighborhood change play an important role in understanding how neighborhoods and gentrification influence health (Hirsch et al., 2021; Weden et al., 2008), and may be particularly important in the context of mental health, which may be more affected by subjective measures of the neighborhood environment (Zhang et al., 2019).

Our study has limitations because of its design, including a non-representative study population and timing of data collection. The experience of gentrification differs based on race and income (Cole et al., 2017; Fullilove & Wallace, 2011; Gibbons, 2019; Tran et al., 2020), however, the INTERACT cohort underrepresents people of color, and is more likely to have higher incomes and be more educated, as compared to demographic data for Montréal (Fuller et al., 2021). In addition, housing tenure (i.e., whether a person owns or rents their home) may have population health effects, particularly given the decline in affordable rental units that often accompanies gentrification processes (Walks et al., 2021). Additionally, renters may be more vulnerable to increased financial strain due to the rising housing costs, and may experience worse mental health due to financial strain as compared to homeowners (Mason et al., 2013; Tran et al., 2020). With a larger and more representative sample, researchers can examine the modifying effect of race, income, and homeowner status on the relationship between

Table 6
Summary of main findings on the links between census-defined gentrification, perceptions of neighborhood change, and mental health among adults in Montréal.

Study findings	Discussion and Implications
Residents living in census tracts that gentrified—and particularly those in tracts with sustained gentrification over a 10-year period—perceived more neighborhood change to the built and social environment, at a faster pace than residents living in neighborhoods that did not gentrify during 2006–2016.	Survey-based measures of perceived neighborhood change can (1) help us understand who perceives changes in their surrounding neighborhoods and who does not and (2) identify how differing <i>perceptions</i> of change, rather than classifying exposure based on the neighborhood they live in, can influence health.
Residents who perceived their neighborhood as more affordable and had more positive feelings about neighborhood changes were more likely to report better mental health than residents who had a more negative outlook on their neighborhood and believed it to be less affordable, regardless of neighborhood gentrification status.	A decrease in neighborhood affordability, whether due to gentrification or not, can negatively impact mental health. Ensuring buy-in for neighborhood revitalization efforts can help create more positive outlook on neighborhood changes and promote mental health.
Perceived social environment changes were associated with worse mental health, regardless of neighborhood gentrification status.	Change to the social environment, such as displacement of neighbors and friends, which may or may not be due to gentrification-related change, can influence one's sense of belonging in their neighborhood and negatively affect mental health. Future studies should examine the causes of displacement and who is more likely to be displaced, and promote anti-displacement strategies, particularly in the context of neighborhood revitalization efforts to promote strong ongoing social support in communities.
We did not observe any correlations between census-defined gentrification and adult mental health. We considered adults who lived in gentrified neighborhoods, the amount of time they lived in the neighborhood, and adults who lived within 250-m of a gentrified neighborhood.	In this study, living in or near a census-defined gentrified neighborhood did not significantly affect mental health, however, duration of time in a neighborhood may matter more for longer-term residents who lived in the neighborhood prior to gentrification. Given that neighborhood residential history only goes back to 2006 in this study, it was not possible to differentiate between long-term residents and newer residents, nor were we able to include former residents who no longer lived in Montréal at the time of data collection.
Residents who perceived that more gentrification had occurred in their neighborhood reported somewhat worse mental health.	Residents who perceived more gentrification also reported worse mental health. Though residents who reported a greater amount of change in general did not report worse mental health. Thus, perceiving gentrification-specific change may be tied to negative associations, such as increases in the costs of living and/or displacement pressure, which may negatively contribute to adult mental health.
Perceived gentrification was correlated with worse mental health for residents, regardless of the census-defined gentrification category that their neighborhood was in.	Living in a census-defined gentrified neighborhood did not change the association between perceiving gentrification and worse mental health. Future observational studies should further examine this interaction.

gentrification and mental health. Data collection also occurred during the COVID pandemic, a time when people were staying home more, and a time when mental health was particularly affected by social isolation (Kumar & Nayar, 2021).

Gentrification can cause displacement, which can negatively affect health through loss of social support and loss of access to health care (Fullilove & Wallace, 2011; Jelks et al., 2021). Complimentary longitudinal analyses, either leveraging the retrospective residential histories or exploring prospective residential histories through regular follow-ups could help explore how exposure to gentrification may have led to displacement, or, inversely, how residential mobility may be linked to participants' contributions to the gentrification of neighborhoods. Additionally, qualitative assessments would be needed to understand how gentrification and displacement might have occurred, and their combined effects on health (e.g., exploring change in cost of living, sense of belonging, social cohesion, etc.).

Future studies should utilize PACER or other survey-based measures of gentrification to capture perceptions of gentrification at multiple points in time to measure how perceptions of neighborhood change vary with objective measures of neighborhood change. This would further validate the use of the PACER tool in capturing resident experiences of change and establish the temporal relationships between perceived neighborhood change and mental health. Survey-based tools such as PACER can help us understand the different experiences of neighborhood change for different groups of residents, elucidate both why people perceive gentrification differently, and built our understanding of how these differing perspectives influence mental health.

Community empowerment is an important component of neighborhood revitalization efforts that is not always considered in neighborhood revitalization efforts, although it is a key ingredient that can help transform the power dynamics between government and citizens, create buy-in for neighborhood change and revitalization efforts, and promote more positive feelings about ongoing changes (Wallerstein, 2006, p. 37). Revitalization and neighborhood change that centers community empowerment can thus improve mental health for residents in neighborhoods undergoing revitalization (Baba et al., 2017). Additionally, revitalization efforts that include anti-displacement strategies to preserve and produce affordable housing, such as a required allotment of affordable housing with new developments, creating housing trust funds to use federal funding to promote long-term affordability, or inclusionary zoning policies, can help mediate rising housing costs that often accompany revitalization efforts and local policies promoting tech and start-up ecosystems. Reducing feelings of unaffordability by protecting existing renters through rent stabilization policies and increased availability of emergency rental assistance, and creating ownership opportunities for long-term renters in the neighborhood through community land trusts and housing cooperatives can additionally buffer against the negative effect of economic strain that many lower-income residents experience in gentrifying neighborhoods (Been, 2017; De Barbieri, 2017; Herrine et al., 2016; Marcuse, 1984; Rose, n.d.; Schten, 2021, p. 103).

6. Conclusion

This study provided evidence of the effect that perceptions of gentrification may have on mental health, with greater perceived affordability and more positive feelings about neighborhood change associated with better mental health, and greater change to social environment associated with worse mental health. Efforts to improve and revitalize neighborhood environments should be implemented alongside policies to protect existing residents from rising cost of living and with accompanying initiatives to promote social cohesion. These efforts can help promote mental health and protect against the negative impact of neighborhood change on mental health.

Author contributions

Youngbloom: Conceptualization, Methodology, writing–original draft preparation, reviewing and editing, visualization. Thierry: Data curation, writing – Reviewing and Editing. Fuller, Kestens, Winters: funding acquisition, writing–review and editing. Hirsch, Michael: Provided resources pertaining to the survey instrument used to measure neighborhood change, writing – review & editing. Firth: Conceptualization, methodology, resources, supervision, writing–original draft, review and editing.

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Consent to participants

All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

Ethics approval

Data for this study came from the INTERventions, Research, and Action in Cities Team (INTERACT) study. Data were deidentified, and this study was a secondary analysis of this data, thus making it exempt from IRB review.

Ethical statement

Data for this study came from the INTERventions, Research, and Action in Cities Team (INTERACT) study. At the time of data collection, ethics approval was received from the Comité d'évaluation de la recherche du Centre hospitalier de l'Université de Montréal (CÉR CHUM 16.397). Subsequently, the project was transferred to Université de Montréal, where ethical approval has been received from their review board (CERSES, 2021-1225).

Consent for publication

All authors consent to publication of this manuscript.

Availability of data and material

Not applicable.

Code availability

Not applicable.

Declarations of competing interest

None.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2023.101406>.

References

- Agbai, C. O. (2021). Shifting neighborhoods, shifting health: A longitudinal analysis of gentrification and health in Los Angeles county. *Social Science Research, 100*, Article 102603. <https://doi.org/10.1016/j.ssresearch.2021.102603>
- Angelovski, I. (2015). Healthy food stores, greenlining and food gentrification: Contesting new forms of privilege, displacement and locally unwanted land uses in racially mixed neighborhoods. *International Journal of Urban and Regional Research, 39*(6), 1209–1230. <https://doi.org/10.1111/1468-2427.12299>
- Angelovski, I., Connolly, J. J. T., Cole, H., Garcia-Lamarca, M., Triguero-Mas, M., Baró, F., Martin, N., Conesa, D., Shokry, G., del Pulgar, C. P., Ramos, L. A., Matheny, A., Gallez, E., Oscilowicz, E., Mániz, J. L., Sarzo, B., Beltrán, M. A., & Minaya, J. M. (2022). Green gentrification in European and North American cities. *Nature Communications, 13*(1). <https://doi.org/10.1038/s41467-022-31572-1>. Article 1.
- Atkinson, R., & Bridge, G. (2004). *Gentrification in a global context* (1st ed.). Routledge. <https://doi.org/10.4324/9780203392089>
- Baba, C., Kearns, A., McIntosh, E., Tannahill, C., & Lewsey, J. (2017). Is empowerment a route to improving mental health and wellbeing in an urban regeneration (UR) context? *Urban Studies, 54*(7), 1619–1637. <https://doi.org/10.1177/00420980166632435>
- Baker, E., Pham, N. T. A., Daniel, L., & Bentley, R. (2020). New evidence on mental health and housing affordability in cities: A quantile regression approach. *Cities, 96*, Article 102455. <https://doi.org/10.1016/j.cities.2019.102455>
- Bassett, E., & Moore, S. (2013). Gender differences in the social pathways linking neighborhood disadvantage to depressive symptoms in adults. *PLoS One, 8*(10), Article e76554. <https://doi.org/10.1371/journal.pone.0076554>
- Been, V. (2017). *What more do we need to know about how to prevent and mitigate displacement of low- and moderate-income households from gentrifying neighborhoods*. Joint Center for Housing Studies of Harvard University. https://www.jchs.harvard.edu/sites/default/files/media/imp/a_shared_future_what_more_do_we_need_to_know_0.pdf.
- Bélanger, H. (2012). The meaning of the built environment during gentrification in Canada. *Journal of Housing and the Built Environment, 27*(1), 31–47.
- Bentley, R., Baker, E., Mason, K., Subramanian, S. V., & Kavanagh, A. M. (2011). Association between housing affordability and mental health: A longitudinal analysis of a nationally representative household survey in Australia. *American Journal of Epidemiology, 174*(7), 753–760. <https://doi.org/10.1093/aje/kwr161>
- Betancur, J. (2011). Gentrification and community fabric in Chicago. *Urban Studies, 48*(2), 383–406. <https://doi.org/10.1177/0042098009360680>
- Bhavsar, N. A., Kumar, M., & Richman, L. (2020). Defining gentrification for epidemiologic research: A systematic review. *PLoS One, 15*(5), Article e0233361. <https://doi.org/10.1371/journal.pone.0233361>
- Chaix, B., Kestens, Y., Perchoux, C., Karusisi, N., Merlo, J., & Labadi, K. (2012). An interactive mapping tool to assess individual mobility patterns in neighborhood studies. *American Journal of Preventive Medicine, 43*(4), 440–450. <https://doi.org/10.1016/j.amepre.2012.06.026>
- Christofore, D., & Leguizamón, S. (2019). Neighbourhood inequality spillover effects of gentrification. *Papers in Regional Science, 98*(3), 1469–1484. <https://doi.org/10.1111/pirs.12405>
- Cole, H. V. S., Lamarca, M. G., Connolly, J. J. T., & Angelovski, I. (2017). Are green cities healthy and equitable? Unpacking the relationship between health, green space and gentrification. *Journal of Epidemiology & Community Health, 71*(11), 1118–1121. <https://doi.org/10.1136/jech-2017-209201>
- Cole, H. V. S., Triguero-Mas, M., Connolly, J. J. T., & Angelovski, I. (2019). Determining the health benefits of green space: Does gentrification matter? *Health & Place, 57*, 1–11. <https://doi.org/10.1016/j.healthplace.2019.02.001>
- Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. *American Journal of Community Psychology, 29*(2), 371–383. <https://doi.org/10.1023/A:1010303419034>
- Curran, W. (2004). Gentrification and the nature of work: Exploring the links in Williamsburg, Brooklyn. *Environment & Planning A: Economy and Space, 36*(7), 1243–1258. <https://doi.org/10.1068/a36240>
- De Barbieri, E. W. (2017). Do community benefits agreements benefit communities? *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3028688>
- Ding, L., Hwang, J., & Divringi, E. (2016). Gentrification and residential mobility in Philadelphia. *Regional Science and Urban Economics, 61*, 38–51. <https://doi.org/10.1016/j.regsciurbeco.2016.09.004>
- Firth, C. L., Fuller, D., Wasfi, R., Kestens, Y., & Winters, M. (2020). Causally speaking: Challenges in measuring gentrification for population health research in the United States and Canada. *Health & Place, 63*, Article 102350. <https://doi.org/10.1016/j.healthplace.2020.102350>
- Firth, C., Thierry, B., Fuller, D., Winters, M., & Kestens, Y. (2020). *Gentrification, urban interventions, and equity (GENUINE): A map-based gentrification tool for Canadian metropolitan areas* [Under Review at Health Reports].
- Firth, C. L., Thierry, B., Fuller, D., Winters, M., & Kestens, Y. (2021). Gentrification, urban interventions and equity (GENUINE): A map-based gentrification tool for Canadian metropolitan areas. *Health Reports, 32*(5), 15–28. <https://doi.org/10.25318/82-003-x202100500002-eng>
- Flanagan, E., Lachapelle, U., & El-Geneidy, A. (2016). Riding tandem: Does cycling infrastructure investment mirror gentrification and privilege in Portland, OR and Chicago, IL? *Research in Transportation Economics*. <https://doi.org/10.1016/j.retrec.2016.07.027>
- Freeman, L. (2005). Displacement or succession?: Residential mobility in gentrifying neighborhoods. *Urban Affairs Review, 40*(4), 463–491.

- Freeman, L., & Braconi, F. (2004). Gentrification and displacement New York city in the 1990s. *Journal of the American Planning Association*, 70(1), 39–52. <https://doi.org/10.1080/01944360408976337>
- Fuller, D., Bell, S., Firth, C. L., Muhajarine, N., Nelson, T., Stanley, K., Sones, M., Smith, J., Thierry, B., Laberee, K., Stephens, Z. P., Phillips, K., Kestens, Y., & Winters, M. (2021). Wave 1 results of the INTERventions, Research, and Action in Cities Team (INTERACT) cohort study: Examining spatio-temporal measures for urban environments and health. *Health & Place*, Article 102646. <https://doi.org/10.1016/j.healthplace.2021.102646>
- Fullilove, M. T., & Wallace, R. (2011). Serial forced displacement in American cities, 1916–2010. *Journal of Urban Health*, 88(3), 381–389. <https://doi.org/10.1007/s11524-011-9585-2>
- Gibbons, J. (2019). Are gentrifying neighborhoods more stressful? A multilevel analysis of self-rated stress. *SSM - Population Health*, 7, Article 100358. <https://doi.org/10.1016/j.ssmph.2019.100358>
- Glass, R. (1964). Aspects of change. In *The gentrification debates: A reader* (pp. 19–30). Taylor & Francis Group. <https://ebookcentral.proquest.com/lib/washington/detail.action?docID=1397036>
- Goldenberg, S. M., Amram, O., Braschel, M., Moreheart, S., & Shannon, K. (2020). Urban gentrification and declining access to HIV/STI, sexual health, and outreach services amongst women sex workers between 2010–2014: Results of a community-based longitudinal cohort. *Health & Place*, 62, Article 102288. <https://doi.org/10.1016/j.healthplace.2020.102288>
- Government of Canada, S. C. (2017). *Illustrated glossary—census tract (CT)*. <https://www150.statcan.gc.ca/n1/pub/92-195-x/2021001/geo/ct-sr/ct-sr-eng.htm>
- Government of Canada, S. C. (2022a). February 9. Profile table, census profile, 2021 Census of population—montréal. Ville (V) [Census subdivision], Quebec <https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E>
- Government of Canada, S. C. (2022b). *The Daily — to buy or to rent: The housing market continues to be reshaped by several factors as Canadians search for an affordable place to call home*. <https://www150.statcan.gc.ca/n1/daily-quotidien/220921/dq220921-b-eng.htm>
- Grube-Cavers, A., & Patterson, Z. (2015). Urban rapid rail transit and gentrification in Canadian urban centres: A survival analysis approach. *Urban Studies*, 52(1), 178–194. <https://doi.org/10.1177/0042098014524287>
- Guan, H., & Cao, H. (2020). Gentrification in the Global South: New insights from Chinese studies (Vol. 87). Boletín de La Asociación de Geógrafos Españoles. <https://doi.org/10.21138/bage.3055>
- Herrine, L., Yager, J., & Mian, N. (2016). Gentrification response: A survey of strategies to maintain neighborhood economic diversity. In *NYU furman center for real estate and urban policy* (p. 24). https://furmancenter.org/files/NYUFurmanCenter_GentrificationResponse_26OCT2016.pdf
- Hirsch, J. A., Grunwald, H. E., Miles, K. L., & Michael, Y. L. (2021). Development of an instrument to measure perceived gentrification for health research: Perceptions about changes in environments and residents (PACER). *SSM - Population Health*, 15, Article 100900. <https://doi.org/10.1016/j.ssmph.2021.100900>
- Hwang, J., & Lin, J. (2016). What have we learned about the causes of recent gentrification? *Citiescape*, 18(3), 9–26.
- Hyra, D., Moulden, D., Wetted, C., & Fullilove, M. (2019). A method for making the just city: Housing, gentrification, and health. *Housing Policy Debate*, 29(3), 421–431. <https://doi.org/10.1080/10511482.2018.1529695>
- Iyanda, A. E., & Lu, Y. (2021a). ‘Gentrification is not improving my health’: A mixed-method investigation of chronic health conditions in rapidly changing urban neighborhoods in Austin, Texas. *Journal of Housing and the Built Environment*. <https://doi.org/10.1007/s10901-021-09847-8>
- Iyanda, A. E., & Lu, Y. (2021b). Perceived impact of gentrification on health and well-being: Exploring social capital and coping strategies in gentrifying neighborhoods. *The Professional Geographer*, 73(4), 713–724. <https://doi.org/10.1080/00330124.2021.1924806>
- Izenberg, J. M., Mujahid, M. S., & Yen, I. H. (2018). Health in changing neighborhoods: A study of the relationship between gentrification and self-rated health in the state of California. *Health & Place*, 52, 188–195. <https://doi.org/10.1016/j.healthplace.2018.06.002>
- Jelks, N. O., Jennings, V., & Rigolon, A. (2021). Green gentrification and health: A scoping review. *International Journal of Environmental Research and Public Health*, 18(3), 907. <https://doi.org/10.3390/ijerph18030907>
- Kestens, Y., Winters, M., Fuller, D., Bell, S., Berscheid, J., Brondeel, R., Cantinotti, M., Datta, G., Gauvin, L., Gough, M., Laberee, K., Lewis, P., Lord, S., Luan, H. H., McKay, H., Morency, C., Muhajarine, N., Nelson, T., Ottoni, C., ... Wasfi, R. (2019). Interact: A comprehensive approach to assess urban form interventions through natural experiments. *BMC Public Health*, 19(1), 51. <https://doi.org/10.1186/s12889-018-6339-z>
- Komakech, M. D. C., & Jackson, S. F. (2016). A study of the role of small ethnic retail grocery stores in urban renewal in a social housing project, Toronto, Canada. *Journal of Urban Health*, 93(3), 414–424. <https://doi.org/10.1007/s11524-016-0041-1>
- Kumar, A., & Nayar, K. R. (2021). COVID 19 and its mental health consequences. *Journal of Mental Health*, 30(1), 1–2. <https://doi.org/10.1080/09638237.2020.1757052>
- López-Morales, E. (2015). Gentrification in the Global South. *City*, 19(4), 564–573. <https://doi.org/10.1080/13604813.2015.1051746>
- Mair, C., Diez Roux, A. V., Golden, S. H., Rapp, S., Seeman, T., & Shea, S. (2015). Change in neighborhood environments and depressive symptoms in New York city: The multi-ethnic study of atherosclerosis. *Health & Place*, 32, 93–98. <https://doi.org/10.1016/j.healthplace.2015.01.003>
- Maloutas, T. (2012). Contextual diversity in gentrification research. *Critical Sociology*, 38(1), 33–48. <https://doi.org/10.1177/0896920510380950>
- Maltais, A., & Bélanger, H. (2021). La gentrification au Québec: Les gens, les lieux, les pratiques. *Recherches Sociographiques*, 62(1), 7–34. <https://doi.org/10.7202/1082611ar>
- Marcuse, P. (1984). To control gentrification: ANti-displacement zoning and planning for stable residential districts. *Review of Law & Social Change*, XIII, 931–945.
- Mason, K. E., Baker, E., Blakely, T., & Bentley, R. J. (2013). Housing affordability and mental health: Does the relationship differ for renters and home purchasers? *Social Science & Medicine*, 94, 91–97. <https://doi.org/10.1016/j.socscimed.2013.06.023>
- McCartney, G., Hearty, W., Taulbut, M., Mitchell, R., Dryden, R., & Collins, C. (2017). Regeneration and health: A structured, rapid literature review | Elsevier enhanced reader. *Public Health*, 148, 69–87. <https://doi.org/10.1016/j.puhe.2017.02.022>
- Mehdipanah, R., Marra, G., Melis, G., & Gelormino, E. (2018). Urban renewal, gentrification and health equity: A realist perspective. *The European Journal of Public Health*, 28(2), 243–248. <https://doi.org/10.1093/eurpub/ckx202>
- Moser, S., Fauveaud, G., & Cutts, A. (2019). Montréal: Towards a post-industrial reinvention. *Cities*, 86, 125–135. <https://doi.org/10.1016/j.cities.2018.09.013>
- Naud, A., Sueur, C., Chaix, B., & Kestens, Y. (2020). Combining social network and activity space data for health research: Tools and methods. *Health & Place*, 66, Article 102454. <https://doi.org/10.1016/j.healthplace.2020.102454>
- Orstad, S. L., McDonough, M. H., Stapleton, S., Altincekic, C., & Troped, P. J. (2017). A systematic review of agreement between perceived and objective neighborhood environment measures and associations with physical activity outcomes. *Environment and Behavior*, 49(8), 904–932. <https://doi.org/10.1177/0013916516670982>
- Oscilowicz, E., Honey-Rosés, J., Anguelovski, I., Triguero-Mas, M., & Cole, H. (2020). Young families and children in gentrifying neighbourhoods: How gentrification reshapes use and perception of green play spaces. *Local Environment*, 25(10), 765–786. <https://doi.org/10.1080/13549839.2020.1835849>
- Press, T. C. (2023). Rent prices grew at record pace in 2022 as Canada saw lowest vacancy rate in decades. CTVNews. Staff, & Contact <https://www.ctvnews.ca/business/rent-prices-grew-at-record-pace-in-2022-as-canada-saw-lowest-vacancy-rate-in-decades-1.6247833>
- Pun, V. C., Manjourides, J., & Suh, H. H. (2018). Association of neighborhood greenness with self-perceived stress, depression and anxiety symptoms in older U.S adults. *Environmental Health*, 17(1), 39. <https://doi.org/10.1186/s12940-018-0381-2>
- Rigolon, A., & Németh, J. (2019). Toward a socioecological model of gentrification: How people, place, and policy shape neighborhood change. *Journal of Urban Affairs*, 41(7), 887–909. <https://doi.org/10.1080/07352166.2018.1562846>
- Rose, K. (n.d.). Combating gentrification through equitable development. *Race, Poverty and the environment*. <https://www.reimaginepe.org/node/919>
- RStudio Team. (2020). *RStudio: Integrated Development for R*. [R; RStudio]. PBC. <http://www.rstudio.com/>
- Schnake-Mahl, A. S., Jahn, J. L., Subramanian, S. V., Waters, M. C., & Arcaya, M. (2020). Gentrification, neighborhood change, and population health: A systematic review. *Journal of Urban Health*, 97(1), 1–25. <https://doi.org/10.1007/s11524-019-00400-1>
- Schten, R. (2021). *White paper on anti-displacement strategy effectiveness*. California Air Resources Board.
- Shaw, K. S., & Hagemans, I. W. (2015). ‘Gentrification without displacement’ and the consequent loss of place: The effects of class transition on low-income residents of secure housing in gentrifying areas. *International Journal of Urban and Regional Research*, 39(2), 323–341. <https://doi.org/10.1111/1468-2427.12164>
- Shmool, J. L. C., Yonas, M. A., Newman, O. D., Kubzansky, L. D., Joseph, E., Parks, A., Callaway, C., Chubb, L. G., Shepard, P., & Clougherty, J. E. (2015). Identifying perceived neighborhood stressors across diverse communities in New York city. *American Journal of Community Psychology*, 56(1–2), 145–155. <https://doi.org/10.1007/s10464-015-9736-9>
- Smith, G. S., Breakstone, H., Dean, L. T., & Thorpe, R. J. (2020). Impacts of gentrification on health in the US: A systematic review of the literature. *Journal of Urban Health*, 97(6), 845–856. <https://doi.org/10.1007/s11524-020-00448-4>
- Stafford, M., Cummins, S., Macintyre, S., Ellaway, A., & Marmot, M. (2005). Gender differences in the associations between health and neighbourhood environment. *Social Science & Medicine*, 60(8), 1681–1692. <https://doi.org/10.1016/j.socscimed.2004.08.028>
- Steinmetz-Wood, M., Wasfi, R., Parker, G., Bornstein, L., Caron, J., & Kestens, Y. (2017). Is gentrification all bad? Positive association between gentrification and individual’s perceived neighborhood collective efficacy in Montreal, Canada. *International Journal of Health Geographics*, 16(1), 24. <https://doi.org/10.1186/s12942-017-0096-6>
- Sullivan, D. M. (2007). Reassessing gentrification: Measuring residents’ opinions using survey data. *Urban Affairs Review*, 42(4), 583–592. <https://doi.org/10.1177/1078087406295828>
- The Chief Public Health Officer’s Report on the State of Public Health in Canada. (2017). *Designing Healthy living* [Education and awareness]. Public Health Agency of Canada, 2017 <https://www.canada.ca/en/public-health/services/publications/chief-public-health-officer-reports-state-public-health-canada/2017-designing-healthy-livin-g.html>
- Tran, L. D., Rice, T. H., Ong, P. M., Banerjee, S., Liou, J., & Ponce, N. A. (2020). Impact of gentrification on adult mental health. *Health Services Research*, 55(3), 432–444. <https://doi.org/10.1111/1475-6773.13264>
- Tulier, M. E., Reid, C., Mujahid, M. S., & Allen, A. M. (2019). Clear action requires clear thinking”: A systematic review of gentrification and health research in the United States. *Health & Place*, 59, Article 102173. <https://doi.org/10.1016/j.healthplace.2019.102173>
- Versey, H. S., Murad, S., Willems, P., & Sanni, M. (2019). Beyond housing: Perceptions of indirect displacement, displacement risk, and aging precarity as challenges to aging

- in place in gentrifying cities. *International Journal of Environmental Research and Public Health*, 16(23), 4633. <https://doi.org/10.3390/ijerph16234633>
- Walks, A., Hawes, E., & Simone, D. (2021). Gentrification in large Canadian cities: Tenure, age, and exclusionary displacement 1991-2011. *Urban Geography*, 42(5), 603–633. <https://doi.org/10.1080/02723638.2020.1832376>
- Wallerstein, N. (2006). *What is the evidence on effectiveness of empowerment to improve health?* WHO Regional Office for Europe.
- Ware, J. E., Kosinski, M., & Keller, S. D. (1995). *How to score SF-12 physical & mental health summary scales* (2nd ed.). New England Medical Center: The Health Institute.
- Weden, M. M., Carpiano, R. M., & Robert, S. A. (2008). Subjective and objective neighborhood characteristics and adult health. *Social Science & Medicine*, 66(6), 1256–1270. <https://doi.org/10.1016/j.socscimed.2007.11.041>
- Wilhelmsson, M., Ismail, M., & Warsame, A. (2021). Gentrification effects on housing prices in neighbouring areas. *International Journal of Housing Markets and Analysis*, 15(4), 910–929. <https://doi.org/10.1108/IJHMA-04-2021-0049>
- Wodtke, G. T., Harding, D. J., & Elwert, F. (2011). Neighborhood effects in temporal perspective: The impact of long-term exposure to concentrated disadvantage on high school graduation. *American Sociological Review*, 76(5), 713–736. <https://doi.org/10.1177/0003122411420816>
- Zhang, L., Zhou, S., & Kwan, M.-P. (2019). A comparative analysis of the impacts of objective versus subjective neighborhood environment on physical, mental, and social health. *Health & Place*, 59, Article 102170. <https://doi.org/10.1016/j.healthplace.2019.102170>
- Zuk, M., Bierbaum, A. H., Chapple, K., Gorska, K., & Loukaitou-Sideris, A. (2018). Gentrification, displacement, and the role of public investment. *Journal of Planning Literature*, 33(1), 31–44. <https://doi.org/10.1177/0885412217716439>
- Rental Market Report (Housing Market Information, p.1-148). (2023). Canada Mortgage and Housing Corporation. <https://assets.cmhc-schl.gc.ca/sites/cmhc/professional/housing-markets-data-and-research/market-reports/rental-market-report/rental-market-report-2022-en.pdf?rev=2a0ed640-6c4c-435d-b13a-0faca94c0667>.