Intersectionality and inequalities in medical risk for severe COVID-19 in the Canadian Longitudinal Study on Aging

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Abstract

Background and Objectives: Older populations with underlying medical conditions are at higher risk of COVID-19 severity and mortality once infected. Intersectional gerontology considers the compounding effects of multiple forms of social inequity. This study explores how racial-nativity status, family income, education level and the intersecting profile of these three social standings stratify differential patterns of chronic conditions among Canadians aged 45 years and older.

Research Design and Methods: Using the baseline Canadian Longitudinal Study on Aging (n = 29,748), multinomial logistic regression analyses were conducted to estimate multivariable-adjusted odds of having one and/or two (≤ 2) or multiple (≥3) medical conditions (i.e., diabetes, asthma, cancer, previous heart attack, cardiovascular disease, kidney disease, hypertension, chronic obstructive pulmonary disease, and obesity) based on socio-demographic characteristics.

Results: There were significant racial-nativity disparities and social-class gradients in multimorbidity. The odds of having ≥3 medical conditions were greater for Black immigrants (OR=1.79, 95% CI=1.13, 2.82), South Asian immigrants (OR=1.49, 95% CI=1.02, 2.19) and close to double for Aboriginal Canadians (OR=1.96, 95% CI=1.37, 2.80) relative to Canadian-born Whites. Black, South Asian and Aboriginal populations from disadvantaged socioeconomic backgrounds had the highest odds of having ≥3 medical conditions (OR=3.50, 95% CI=1.41, 8.70).

Discussion and Implications: Despite a universal health system, marginalized older Canadians who are racialized foreign-born, less educated, and/or low-income have a higher prevalence of multimorbidity that are associated with COVID-19 severe illness and mortality. Upstream health policy and social care tackling intersecting structural inequities should be undertaken to prevent increasing multimorbidity among underserved aging populations.

Keywords: COVID-19; Multimorbidity; Health inequalities; ethnicity and health; Canadian Longitudinal Study on Aging (CLSA); Intersectionality
Background

Although the novel coronavirus disease 2019 (COVID-19) can infect anyone, racialized and impoverished populations carry a disproportionate burden of the disease (Abrams & Szefler, 2020; Ahmed, Ahmed, Pissarides, & Stiglitz, 2020; Bambra, Riordan, Ford, & Matthews, 2020), which has heightened awareness of existing health gaps between the privileged social groups and those vulnerable populations. Similar to previous outbreaks of influenza and severe acute respiratory syndrome (Quinn et al., 2011), what the COVID-19 pandemic brings to the forefront is that both exposure to health hazards and access to health-enhancing resources are fundamentally different based on race, nativity, class and many other social positions (Wright, Steptoe, & Fancourt, 2020), also known as social determinants of health (Marmot, 2005). A burgeoning body of evidence has demonstrated overrepresentation of racialized, low-income, and other socially marginalized populations among cases of and deaths from COVID-19 across the globe. For example, in the USA, counties in which the majority of the population are Black have three times the prevalence of COVID-19 and six times the fatality rate of White majority counties (Dyer, 2020). These Black-White gaps in COVID-19 mortality are especially prominent among middle-aged Americans (Ford, Reber, & Reeves, 2020). In the UK, persons with disadvantaged socioeconomic backgrounds suffered from greater adversities in the lockdown due to COVID-19, including higher rates of job loss, food insecurity, lower access to medication, and inability to pay bills (Wright et al., 2020).

Social inequalities in pre-existing medical conditions

The framework of the World Health Organization (WHO) Commission on Social Determinants of Health (SDoH) asserts that social vulnerabilities, produced by one’s multiple social locations in hierarchical social orders (Bourgois, Holmes, Sue, & Quesada, 2017), are root causes of population health inequalities in the upstream casual pathway to ill-health (WHO, 2008). In the case of the COVID-19 pandemic, the distal impact of social vulnerabilities, such as racial stratification and poverty, could be transmitted through many downstream channels (Krieger, Nancy, 2005; Link &
Phelan, 1995; Palmer, Ismond, Rodríguez, & Kaufman, 2019). These proximal risk factors may include underlying medical conditions (e.g., heart disease, hypertension, chronic kidney disease, asthma, obesity) that have been associated with critical illness among COVID-19 patients (Bello-Chavolla et al., 2020; Petrilli et al., 2020). For example, previous studies have suggested that the most deprived populations were 60% more likely to develop chronic kidney disease than their wealthiest counterparts (Webster, Nagler, Morton, & Masson, 2017). Aboriginal populations in Canada and Australia, Hispanics in the USA, and Black people in the UK had a higher likelihood of chronic kidney disease than their White peers (Morton et al., 2016). Likewise, social inequalities in cardiovascular disease (Harper, Lynch, & Smith, 2011), cancers (Hovanec et al., 2018; Merletti, Galassi, & Spadea, 2011), body-mass index (Bann, Johnson, Li, Kuh, & Hardy, 2018; Kim, Kawachi, Coull, & Subramanian, 2018), and asthma-related mortality (Gupta, Mukherjee, Sheikh, & Strachan, 2018) are well documented across the life course. This research on social inequalities underscores the necessity of considering social conditions in which people live and grow to address population health disparities.

Previous research has demonstrated the individual-level etiologic mechanism to explain how social inequalities could “get under the skin” via biological regulatory systems (Seeman, Epel, Gruenewald, Karlamangla, & McEwen, 2010). Adversities and stressors faced by vulnerable populations, including food and employment insecurity, precarious housing and barriers to accessing quality health and social services (Raphael, Curry-Stevens, & Bryant, 2008), impose physiological and psychological harm (Kawachi, Subramanian, & Almeida-Filho, 2002). Mounting evidence (Seeman et al., 2010) suggests that individuals in disadvantaged social conditions are more susceptible to circumstances that exceed their coping resources and thus are chronically exposed to unmanaged stress (Phelan & Link, 2005; Phelan, Link, & Tehranifar, 2010; Williams, Lawrence, & Davis, 2019). Exposure to chronic stress increases the allostatic load, a measure of multiple physiologic parameters such as blood pressure and cholesterol levels (Geronimus, Hicken, Keene, & Bound,
2006), resulting in a wide range of negative health and illness outcomes (James et al., 2006; Seeman et al., 2010).

**Intersectionality of race, nativity and social class**

While health inequalities are well documented in relation to race/ethnicity (Siddiqi, Shahidi, Ramraj, & Williams, 2017; Veenstra, 2009; Veenstra & Patterson, 2016), nativity (Davison et al., 2020) and socioeconomic status (Minkler, Fuller-Thomson, & Guralnik, 2006), prior research has typically examined these health differences separately. In immigrant health literature, the conventional approach tends to homogenise the experience of racialized and White immigrants (Brown, 2018). The intersectionality lens of race, immigration and old age has been largely overlooked (Gkiouleka, Huijts, Beckfield, & Bambra, 2018). Ignoring the heterogeneity among immigrant populations is a serious shortcoming because race/ethnicity, language and cultural differences may cumulatively influence the health and wellbeing of immigrants who are aging in a foreign land (Ferrer, Grenier, Brotman, & Koehn, 2017). As such, intersectionality theory has much to offer to population health research because it unpacks various minority struggles that are often obscured within a discourse of multiculturalism and diversity (Hankivsky & Christoffersen, 2008). Therefore, an investigation of how race, nativity and social class combine to shape health outcomes in late life is warranted.

**Objectives**

The arrival of COVID-19 in Canada presents an unprecedented public health challenge, with over one hundred thousand confirmed cases, eight thousand death to date (Public Health Agency of Canada, 2020a), and a crude case fatality rate of 4.9% on April 22, 2020 (Abdollahi, Champredon, Langley, Galvani, & Moghadas, 2020), which is substantially greater than seasonal influenza death rate of approximately 0.1% (Jordan, Adab, & Cheng, 2020). Although the Canadian government has taken rapid response measures to slow the rate of COVID-19 infection and to mitigate the risk of
severe complications (Public Health Agency of Canada, 2020b), few studies have been devoted to identifying which older populations in Canada are facing greater challenges because of the pre-existing epidemics of chronic disease. Given that Canada does not collect socio-demographic and race-based data on COVID-19 cases at the federal level (Osman, 2020), there is no investigation of the impact of social inequalities on COVID-19 testing, infection and mortality rates in Canada. Alternatively, using observational databases that captured demographic patterns and clinical characteristics of the Canadian population in previous years could offer reasonable estimates for health risk assessment in the ongoing pandemic. This retrospective approach to evaluate population at risk has been applied in preventive science (Gibson & Greene, 2020; Raifman & Raifman, 2020).

Intersectional gerontology as a critical lens illuminates the compounding effects of inequity and places the experience of those inequities within the context of systemic oppression among older persons (Koehn, Neysmith, Kobayashi, & Khamisa, 2013). Guided by the intersectionality lens of SDoH, this study aimed to explore the differential patterns of pre-existing multimorbidity known to be associated with COVID-19 mortality by (1) racial-nativity status; (2) family income; (3) education; and (4) the intersecting profile of these three social positionings. This study has important implications for health equity policy and provides a timely frame of reference for public health decision-makers, which may help to improve surveillance systems, allocate critical care interventions, advance health equity and mitigate the pandemic’s long-term societal harms. Recognizing that minority communities with adverse social determinants may be more susceptible to severe forms of COVID-19 (Abrams & Szefler, 2020; Ahmed et al., 2020; Dyer, 2020; Wright et al., 2020), the present study examined the following three hypotheses.
**H1 Racial-nativity inequalities hypothesis:** Older adults who are racialized and foreign-born would be more likely to have pre-existing medical conditions, compared to Canadian-born Whites.

**H2 Socioeconomic inequalities hypothesis:** Older adults who are less educated and/or low-income would be more likely to have pre-existing medical conditions, compared to their peers in higher social class.

**H3 Intersecting inequalities hypothesis:** Multiple jeopardies of three disadvantaged social positions in terms of racial-nativity, income and education would put older adults at a higher risk of having pre-existing medical conditions, compared to their peers with relative social privilege.

**Methods**

**Data Sources and Study Population**

This study used the comprehensive cohort data (n=30,163) from the baseline collection (2012-2015) of the Canadian Longitudinal Study on Aging (CLSA), a unique population-based study of community-dwelling Canadians aged 45 to 85 who will be followed for 20 years across 10 provinces (Raina et al., 2009). The detailed methodology of the CLSA has been previously published (Davison et al., 2020; Lin et al., 2020). The CLSA excludes Canadians residing in long-term care facilities, on First Nations reserves, members of the armed forces, non-English or non-French speakers, and those with dementia. The comprehensive cohort data were collected through in-home face-to-face interviews and at 1 of 11 data collection sites. In this study, participants were excluded if they did not respond to the survey questions about all of the underlying medical conditions (n=67), racial-nativity status (n=125) or relationship status (n=90). This yielded to a final sample size of 29,748 respondents.
**Study Variables**

*Pre-existing medical conditions as risk factors for COVID-19 severity.* This study estimated the proportion of adults having one or more out of nine underlying medical conditions that have been identified as clinical risk factors for severe illness from COVID-19 by the U.S. Centers for Disease Control and Prevention (Raifman & Raifman, 2020). Consistent with recent U.S. studies (Gibson & Greene, 2020; Raifman & Raifman, 2020), these nine physician-diagnosed medical conditions include: diabetes, asthma, cancer, previous heart attack or myocardial infarction, kidney disease, cardiovascular disease (angina or chest pain due to heart disease), hypertension, chronic obstructive pulmonary disease (COPD), and obesity (as assessed by body mass index >30 kg/m²). The outcome measure was an aggregated variable grouped into 3 levels: none; ≤ 2 medical conditions; and ≥ 3 medical conditions (i.e., multimorbidity).

*Social determinants of health (SDoH).* In light of the WHO’s SDoH paradigm (Marmot, 2005), racial-nativity status, income and education levels were selected as three key equity stratifiers in this study. Racial-nativity status was classified into 11 groups, including Canadian-born (CB) categories (White, non-White), aboriginal Canadians (including First Nations, Inuit and Métis) and eight foreign-born (FB) categories by their self-identified racial backgrounds (i.e., White, Black, Latin American, East Asian, West Asian, South Asian, Southeast Asian and others) (Gkiouleka et al., 2018). Because of small numbers, Filipinos were combined with Southeast Asians and Arabs with West Asians (Quan et al., 2006). The operationalization of racial-nativity status recognizes race as a social construct rooted in broader structures of racial oppression (Krieger, N., 2000) and immigration as a complete realignment of life (Castañeda et al., 2015). Due to the small sample size (n=242), detailed ethnic groups could not be disaggregated among Canadian-born non-Whites. Highest level of education was divided into four categories: grade 11 or less, high-school graduate, some college, and post-secondary education. Income was defined as the household income received by all family
members in the past 12 months (<$20k; $20k to <$50k; $50k to <$100k; $100k to <$150k; ≥$150k, and non-response).

**Intersecting social vulnerability.** Informed by the intersectionality lens to examine multiple forms of marginalization (Gkiouleka et al., 2018; Kapilashrami & Hankivsky, 2018; Shi & Stevens, 2005), a cumulative profile of social vulnerabilities was created to identify respondents in one or more out of three disadvantaged social positions: racial-nativity minorities status (South Asian immigrants, Black immigrants, aboriginal Canadians), middle-to-lower annual household income (<$50k), less educated (≤ high school graduates). These three racial categories were selected as they have been consistently associated with adverse health outcomes (e.g., hypertension, diabetes) in Canada (Chiu, Maclagan, Tu, & Shah, 2015; Ramraj et al., 2016; Veenstra, 2009). Since only 4.4% respondents with <$20k household income, we adopted <$50k as the cut-off value that was less than the median after-tax income for senior families ($63,500) reported in 2018 Canadian income survey.

**Covariates.** To consider other potential confounders and/or effect modifiers known to be involved in the ageing process, control variables include social demographics (age groups, sex, marital status, retirement status), health indicators (chronic pain, functional limitation), a behavioral health risk factor (never-vs.-ever smokers using the cut-off value of 100 cigarettes per lifetime), and health care utilization (past-year contact with general practitioners). Functional limitation assessed respondent’s capacity to perform basic and instrumental activities of daily living (ADLs) such as eating or bathing (Fillenbaum & Smyer, 1981) and the summation index was dichotomized into two levels of ADLs impairments.
Statistical Analysis

Weighted statistics were applied to describe sample characteristics by racial-nativity status. The weights provided by CLSA were normalized to produce population-representative estimates corrected for the sample size and nonresponse bias. First, chi-square tests were used to test the statistical differences at the bivariate level. Second, multinomial logistic regression models were undertaken to calculate multivariable-adjusted odds ratio (OR) and 95% confidence intervals (95% CI) of having ≤ 2 and ≥ 3 medical conditions (risk factors) for racial-nativity, income and educational levels, after controlling for known health determinants. Third, multinomial logistic regression analysis was for the same outcome measure included the cumulative profile of social vulnerabilities as the key explanatory variable adjusted for covariates. Lastly, a sensitivity test was conducted for two stratified samples by age (middle-aged group: 45-65; older-aged group: 66-85) to examine whether racial health inequalities are consistent between younger and older generations. Statistical analyses and data management were performed using SPSS software package, Version 26 (IBM Corp., Armonk, N.Y., USA). A p-value <.05 (two-tailed) was considered statistically significant.

Results

Sample characteristics and prevalence of risk factors

[Editor: please insert Table 1 & Figure 1 here from the Appendix]

Table 1 summarizes the sample characteristics for all variables by racial-nativity status. The sample (n=29,748) mainly consisted of respondents who were Canadian-born White (80%), aged 45–76 years (82.5%), earning > $50,000/year (67.3%), in a relationship (68.7%), had a post-secondary diploma or degree (77.5%), had no/mild ADLs impairment (98.6%), had no chronic pain (76.4%) and had past-year contacts with family doctors (84.1%). The sex distribution was even (men: 49%; women: 51%). Around half of the sample was ever smoker (50.4%) and retired (56.8%). Approximately 68% of the middle-aged and older Canadians (n=20,248) had at least one pre-existing
medical condition that had placed them at higher risk of severe illness from COVID-19. Fourteen percent of respondents (n=5,033) had three or more of these medical conditions. Among racial immigrants (average time since immigration: 42.7 years), aboriginal populations, Black immigrants and South Asian immigrants were over-represented in low-income group (<$20k: 7.4%, 6.7%, 8.4%) compared to Canadian-born Whites (4.5%). Only 4.6% (n=244) of immigrants had lived in Canada fewer than 10 years. All aforementioned categorical indicators were significantly linked to the underlying medical conditions and thus were included the multivariable analyses.

Figure 1 illustrates weighted prevalence of nine specific underlying medical conditions stratified by race-nativity status. The most prevalent medical condition for the overall sample was hypertension (32%), followed by obesity (27.5%), diabetes (15.4%), asthma (13.6%), cancer (12.5%), COPD (4.8%), previous heart attack (3.6%), angina (3.5%) and kidney disease (2.6%). Among racial communities, aboriginal populations, Black immigrants and South Asian immigrants had the highest prevalence of obesity (40.3%), hypertension (44.6%) and diabetes (31.2%), respectively. All differences in these nine medical conditions by race-nativity status were significant based on chi-square tests (p<0.05), except for kidney disease (p=0.30) and heart attack (p=0.12).

Multivariable logistic regression

Table 2 displays the unweighted counts of overall sample characteristics, weighted prevalence and multivariable-adjusted odds of having one and/or two (≤ 2) and multiple (≥3) underlying medical conditions. Figure 2 shows a series of eight figures including four bar charts of weighted prevalence (Figure 2A, 2C, 2E, 2G) and four odds ratio plots of logistic-regression analyses (Figure 2B, 2D, 2F, 2H) stratified by each social position. All selected covariates were associated with multimorbidity and thus they were retained in the statistical model (see Table 2). Older age (ORs range 2.38-4.57), being male (OR=1.52), being single (OR=1.14), chronic pain (OR=2.29), ADLs disability (OR=2.39), being retired (OR=1.25), lifetime smoking >100 cigarettes (OR=1.52) and past-year contact with family doctors (OR=2.96) were all linked to increased likelihood of multimorbidity.
Racial-nativity inequalities (H1)

As shown in Table 2, even after adjusting for confounders, several minority populations had significantly elevated risk of having multiple medical conditions. Figure 2A and 2B display these racial-nativity gaps in multimorbidity prevalence and odds ratios. The aboriginal and black communities were affected disproportionately. In the adjusted logistic-regression analyses, 58.7% of Black immigrants (OR=1.74, 95% CI=1.27, 2.37) and 53.7% of aboriginal populations (OR=1.52, 95% CI=1.16, 1.99) were at higher risk of having 1-2 medical conditions relative to 49.7% of White adults. Similarly, the odds of having ≥ 3 medical conditions were greater for Black immigrants (OR=1.79, 95% CI=1.13, 2.82), South Asian immigrants (OR=1.49, 95% CI=1.02, 2.19) and close to double for aboriginal populations (OR=1.96, 95% CI=1.37, 2.80) relative to Canadian-born Whites. On the contrary, White immigrants (OR=0.83, 95% CI=0.74, 0.93) and East Asian immigrants (OR=0.31, 95% CI=17, 0.57) both experienced decreased odds of having multiple underlying medical conditions, when compared to Canadian-born Whites. There were no significant differences in either outcome measure for Canadian-born non-White, Latin American immigrants, Southeast Asian immigrants and other racialized immigrants when compared to Whites born in Canada. A separate sensitivity test (available upon request) further indicated an age-stratification pattern where racial-nativity gaps in multimorbidity were wider among participants aged 66 to 85 years: Black immigrants and Aboriginal Canadians had 5 times (OR=5.11, 95% CI=1.89-13.80) and almost 3 times (OR=2.78, 95% CI=1.34, 5.76) higher odds of having ≥ 3 medical conditions respectively, compared to Canadian-born Whites.

Socioeconomic inequalities (H2)

A salient social-class gradient in underlying medical conditions of severe COVID-19 illness stood out, especially among those with ≥ 3 medical conditions (see Table 2). As shown in Figure 2C and 2D, there was a dose-response relationship between family income level and multiple medical
conditions. In other words, with decreasing income, the odds of reporting ≥ 3 medical conditions significantly escalated, ranging from middle-income persons with 17% higher odds (OR=1.17, 95% CI=1.01, 1.34) to individuals in the poorest bracket having close to two-and-a-half greater odds (OR=2.44, 95% CI=1.96, 3.04), compared to the wealthiest respondents. Likewise, as illustrated in Figure 2E and 2F, there was a similar dose-response pattern between educational attainment and multiple medical conditions. As education level decreased, a greater proportion of respondents reported having ≥ 3 medical conditions (ORs range from 1.21 to 2.10), among whom the odds of having ≥ 3 medical conditions in the lowest educational group rose more than two times (OR=2.10, 95% CI=1.76, 2.50) in comparison to their peers in the highest educational bracket. The educational gradient was also visible in the odds of having ≤ 2 medical conditions (ORs range from 1.11 to 1.15), whereas the income gradient was less pronounced.

*Intersecting social vulnerabilities (H3)*

Table 2 also demonstrates a clear dose-response relationship between cumulative social vulnerabilities and the possibility of having underlying medical conditions which are risk factors of severe COVID19 illness. This association remained even after controlling for known covariates. As depicted in Figure 2G and 2H, individuals who had more social vulnerabilities had higher odds of having multiple medical conditions. The largest jump in odds was observed in the transition from one to two social vulnerabilities. While a single marginalized status had 64% higher odds of having ≥ 3 medical conditions (OR=1.64, 95% CI=1.50, 1.79), adding a second social vulnerability more than tripled the likelihood (OR=3.08, 95% CI=2.03, 4.66), compared to those in the privileged status with no social vulnerability. The most marginalized group with a combination of three vulnerable conditions (i.e., racialized populations without any post-secondary education who are earning less than the median household income) had the highest odds of having ≥ 3 medical conditions (OR=3.50, 95% CI=1.41, 8.70).
Discussion

The current investigation examined the relationship between three sources of social status (i.e., income, education and racial-nativity status) and the prevalence of having multiple medical conditions among Canadians who aged 45 years and older. These relationships may shed some light on who may have higher susceptibility to negative sequelae of COVID-19 illness. The findings reveal that multimorbidity is more prevalent among marginalized people who are Aboriginal, South Asian immigrants, Black immigrants, those with less educational attainment, and those living in low-income households in comparison to those who are White, more educated and/or wealthier. The results of this research indicate that health inequities by social status exist in Canada as they do in the US (Raifman & Raifman, 2020). Despite the fact that Canada has a universal health system and the USA has a market-oriented health system, Canada is not immune to structural drivers of health disparities (Ramraj et al., 2016; Siddiqi et al., 2017).

The racial-nativity inequalities hypothesis (H1) was partially supported because Aboriginal, Black and South Asian individuals, but not all racialized immigrants, had health disadvantages which persisted regardless of demographic, socioeconomic, and behavioural factors. Such inequalities observed in this study are consistent with previous research in Canada (Chiu et al., 2015; Ramraj et al., 2016; Veenstra & Patterson, 2016), UK (Raisi-Estabragh et al., 2020) and the U.S. (Dyer, 2020; Quinn et al., 2011). The magnitude of aboriginal-White inequalities in multimorbidity was as large as the health gap between the lowest and highest educational groups, which highlights the health impact of colonization on First Nations communities. The social-class gradient in multimorbidity prevalence confirms the socioeconomic inequalities hypothesis (H2) and is in keeping with prior epidemiological studies (Luchenski, Quesnel-Vallée, & Lynch, 2008; Mondor, Cohen, Khan, & Wodchis, 2018; Sakib, Shooshtari, St John, & Menec, 2019). Supporting the intersecting inequalities hypothesis (H3), the largest health gap was found when racial minority identity, immigration status and unfavorable socioeconomic positions were combined, which substantiates the utility of
intersectionality as an analytical tool for examining health inequalities (Bauer, 2014). This finding adds to the emerging scholarship that bridges structural, intersectional and health equity lenses to ageing and immigration research (Grenier, et al., 2019; Viruell-Fuentes, Miranda, & Abdulrahim, 2012).

This study extends existing research on the healthy immigrant effect (HIE), a phenomenon that immigrants appear to in better health than the host populations, resulting from the selective immigration policy and mandatory health screening (Vang et al., 2017; Kobayashi & Prus, 2012). The findings show that, relative to Canadian-born Whites, White and East Asian immigrants have a persistent health advantage, whereas Black and South Asian immigrants have significant worse health consequences and other racialized immigrants (i.e., Latin American, West Asian and Southeast Asian) tend to have comparable health profiles. This study challenges previous studies that may overgeneralize the HIE experience to racial minority immigrants in mid-to-late life (McDonald & Kennedy, 2004; Newbold, 2006). In line with intersectionality research (Adjei, Adu, & Ackah, 2020; Brown, 2018; Kobayashi & Prus, 2012), this study suggests that, for Black and South Asian immigrants, any immigrant health advantage may be offset by cumulative exposure to stressors (e.g., language difficulties, racism, cultural misunderstanding) in the post-migration period that lead to the accumulation of chronic conditions at later life stages (Bailey et al., 2017).

The findings of our study are particularly relevant in the context of COVID-19 pandemic, where racialized and socially disadvantaged individuals experience structural inequities that increase the risk of exposure to pathogens (Wright et al., 2020), such as precarious work which require extensive interaction with the public (e.g. retail positions, cleaners, or cashiers), the need to use public transit rather than driving a car (Van et al., 2020), and living in overcrowded housing that makes self-isolation difficult (Selden & Berdahl, 2020). Racialized populations are also over-represented in frontline healthcare occupations including personal support worker and nursing (Raphael et al., 2008). Blacks and Aboriginals in Canada are more prone to everyday discrimination.
associated with chronic conditions (Siddiqi et al., 2017) and the experiences of othering may be further reinforced during the COVID-19 crisis (Devakumar, Shannon, Bhopal, & Abubakar, 2020). Many of the First Nations, Inuit and Métis communities locate in remote areas resulting in geographical barriers to accessing timely medical care.

**Limitations**

This study has several strengths, including its large sample size, its ability to include measures of intersecting social positions, its pragmatic categorization of diverse racialized immigrant populations and its attention to the clustering of underlying medical conditions. However, several methodological flaws and biases limited the generalisability of this study. Relatively small sample sizes of certain minority groups and low response rates in the CLSA have weakened the study’s power. This study relied on self-reported survey data and may induce recall bias. The non-random sample seems to be unusually well-educated, perhaps due to self-selection. The reported rates of chronic diseases from this healthy sample may, therefore, be lower than actual prevalence in the Canadian population. This is particularly true for immigrants who were more likely to have had post-secondary education than Canadian-born Whites in this sample and thus survival bias may be stronger in these populations that could lead to an underestimation of racial-nativity inequalities.

The CLSA baseline survey does not cover all underlying conditions (i.e., liver disease, HIV, hepatitis) identified by the CDC or any direct measures of COVID-19 confirmed cases. Because of the sensitive nature of income reporting, the CLSA only collected family income information in categorical format, which is subject to an unquestioned assumption that material resources are distributed equally according to needs within the household. The absence of absolute income value precludes further calculation of income-to-needs ratios to adjust for the poverty threshold and family size. Since CLSA only includes participants speaking English or French, immigrants facing language barriers were less likely to be surveyed and at elevated risk of under-detection of health problems. In addition, the CLSA excludes individuals residing in nursing home where are the loci of
COVID-19 transmission in Canada thus represents a large national sample of Canadians living in the community. Lastly, many individuals with medical conditions may have not been diagnosed. Such a limitation of under-reporting would probably bias the results toward the null and result in an underestimate of the population at risk of severe COVID-19 illness.

Conclusion

Overall, this nationwide study has demonstrated inequalities by race, nativity, income and education in the prevalence of pre-existing medical conditions associated with greater COVID-19 severity among middle-aged and older Canadians in a universal health system. Such multimorbidity inequalities are potentially amenable to policy beyond the scope of the traditional health sector. Policies that redistribute resources could address this problem (Phelan et al., 2010), for example, by expanding social welfare programs (e.g., old-age pension, unemployment insurance, public housing). Such policies could tackle upstream social inequities and enhance vulnerable individuals’ capacity to cope with day-to-day life challenges during a public health emergency (Wang & Tang, 2020). Another rapid approach lies in redirecting health-enhancing resources to people living in lower-income and minority communities. This initiative involves the formulation of community outreach and health screening programs targeted for vulnerable older adults that are potentially left behind by the current health system. With COVID-19 spreading globally, health equity should be placed at the center of all policy responses designed to mitigate the disproportionate impact of the pandemic on underserved aging communities.
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https://doi.org/10.1136/jech-2020-214475
Table 1 Sample characteristics (weighted %) by racial-nativity status in the CLSA (n=29,748)

|                | CB White | CB non-White | FB White | FB East Asian | FB South Asian | FB Black | FB Southeast Asian | FB Latin American | FB West Asian | Other immigrants | Aboriginals |
|----------------|----------|--------------|----------|---------------|----------------|----------|--------------------|-------------------|----------------|-----------------|-------------|
| Sample size    | 23802    | 242          | 4264     | 173           | 268            | 200      | 114                | 119               | 126            | 102             | 338         |
| Age            |          |              |          |               |                |          |                    |                   |                |                 |             |
| 45 to 55       | 42.1%    | 60.7%        | 33.9%    | 59.1%         | 53.8%          | 54.5%    | 46.7%              | 62.9%             | 69.2%          | 47.1%          | 54.7%       |
| 56 to 65       | 30.8%    | 23.1%        | 25.7%    | 26.0%         | 24.4%          | 20.5%    | 33.6%              | 25.9%             | 24.9%          | 28.8%          | 27.3%       |
| 66 to 75       | 16.3%    | 7.8%         | 24.8%    | 10.3%         | 11.7%          | 16.5%    | 12.4%              | 8.2%              | 3.0%           | 18.3%          | 14.1%       |
| 76 to 85       | 10.7%    | 8.5%         | 15.6%    | 4.5%          | 10.0%          | 8.5%     | 7.3%               | 2.9%              | 3.0%           | 5.8%           | 3.9%        |
| Sex            |          |              |          |               |                |          |                    |                   |                |                 |             |
| Male           | 48.8%    | 45.9%        | 51.9%    | 55.0%         | 61.9%          | 55.4%    | 50.7%              | 62.4%             | 63.3%          | 47.1%          | 47.6%       |
| Female         | 51.2%    | 54.1%        | 48.1%    | 45.0%         | 38.1%          | 44.6%    | 49.3%              | 37.6%             | 36.7%          | 52.9%          | 52.4%       |
| Family income  |          |              |          |               |                |          |                    |                   |                |                 |             |
| < $20k         | 4.5%     | 5.1%         | 2.9%     | 2.5%          | 8.4%           | 6.7%     | 7.3%               | 5.9%              | 5.3%           | 2.9%           | 7.4%        |
| $20k to <$50k  | 17.4%    | 13.9%        | 17.8%    | 17.4%         | 18.1%          | 28.4%    | 19.0%              | 30.8%             | 29.6%          | 16.5%          | 13.5%       |
| $50k to <$100k | 31.3%    | 24.4%        | 32.5%    | 31.1%         | 31.1%          | 27.6%    | 35.0%              | 30.8%             | 32.5%          | 37.9%          | 33.8%       |
| <$100k to <$150k | 21.3%   | 24.1%        | 20.0%    | 18.3%         | 12.7%          | 18.7%    | 18.2%              | 17.2%             | 14.8%          | 25.2%          | 22.5%       |
| ≥ $150k        | 20.1%    | 26.1%        | 20.3%    | 20.7%         | 22.4%          | 8.9%     | 16.8%              | 10.7%             | 9.5%           | 11.7%          | 18.6%       |
| Not answered   | 5.4%     | 6.4%         | 6.4%     | 10.0%         | 7.4%           | 9.8%     | 3.6%               | 4.7%              | 8.3%           | 5.8%           | 4.2%        |
| Education      |          |              |          |               |                |          |                    |                   |                |                 |             |
| <high school   | 5.4%     | 1.7%         | 2.7%     | 0.4%          | 2.0%           | 4.0%     | 1.4%               | 2.4%              | 3.6%           | 2.9%           | 5.2%        |
| High school    | 9.6%     | 7.8%         | 6.9%     | 3.3%          | 5.4%           | 4.0%     | 2.9%               | 4.1%              | 4.1%           | 5.7%           | 9.0%        |
| Some post-secondary | 6.7% | 7.4%         | 7.1%     | 5.0%          | 2.7%           | 8.4%     | 2.9%               | 4.1%              | 2.4%           | 10.5%          | 11.0%       |
| Post-secondary | 78.3%    | 83.1%        | 83.0%    | 91.3%         | 89.9%          | 83.1%    | 92.8%              | 88.2%             | 89.3%          | 81.0%          | 74.8%       |
| Not answered   | 0.1%     | 0.0%         | 0.4%     | 0.0%          | 0.0%           | 0.4%     | 0.0%               | 1.2%              | 0.6%           | 0.0%           | 0.0%        |
| Relationship   |          |              |          |               |                |          |                    |                   |                |                 |             |
| Single/separated | 24.9%  | 24.4%        | 20.8%    | 15.3%         | 12.7%          | 28.6%    | 18.1%              | 15.3%             | 8.3%           | 19.0%          | 29.9%       |
| Married        | 75.1%    | 75.6%        | 79.2%    | 84.7%         | 87.3%          | 71.4%    | 81.9%              | 84.7%             | 91.7%          | 81.0%          | 70.1%       |
### Chronic pain

|                | FB 19.5% | CB 14.2% | CB 19.3% | CB 9.5% | CB 23.4% | CB 18.7% | CB 13.8% | CB 17.6% | CB 23.2% | CB 20.0% | CB 30.9% |
|----------------|----------|----------|----------|---------|----------|----------|----------|----------|----------|----------|----------|
| Have pain      | 76.7%    | 80.4%    | 76.6%    | 81.8%   | 71.2%    | 71.1%    | 71.0%    | 72.4%    | 70.2%    | 76.2%    | 64.6%    |
| No pain        | 3.8%     | 5.4%     | 4.1%     | 8.7%    | 5.4%     | 10.2%    | 15.2%    | 10.0%    | 6.5%     | 3.8%     | 4.5%     |
| Not answered   | 96.2%    | 94.6%    | 95.9%    | 91.3%   | 89.8%    | 89.8%    | 89.0%    | 89.0%    | 96.2%    | 94.6%    | 95.9%    |

### ADLs disability

|                | FB 1.0% | CB 0.7% | CB 1.0% | CB 0.8% | CB 2.7% | CB 0.0% | CB 0.0% | CB 1.2% | CB 1.2% | CB 0.0% | CB 0.6% |
|----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Severe disability | 98.6%   | 99.3%   | 98.6%   | 99.2%   | 96.7%   | 100.0%  | 96.4%   | 97.6%   | 97.0%   | 100.0%  | 99.0%   |
| No/mild disability | 96.2%   | 94.6%   | 95.9%   | 91.3%   | 89.8%   | 89.8%   | 89.0%   | 89.0%   | 96.2%   | 94.6%   | 95.9%   |
| Not complete     | 96.2%   | 94.6%   | 95.9%   | 91.3%   | 89.8%   | 89.8%   | 89.0%   | 89.0%   | 96.2%   | 94.6%   | 95.9%   |

### Retirement status

|                | FB 43.3% | CB 29.4% | CB 47.6% | CB 31.4% | CB 26.3% | CB 26.8% | CB 19.4% | CB 14.2% | CB 29.5% | CB 33.1% |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Retired        | 56.4%    | 70.6%    | 51.8%    | 68.6%    | 67.6%    | 72.8%    | 73.2%    | 80.6%    | 85.8%    | 70.5%    | 65.3%    |
| Not retired    | 0.0%     | 0.0%     | 0.6%     | 0.0%     | 1.0%     | 0.9%     | 0.0%     | 0.0%     | 0.0%     | 1.6%     | 0.0%     |

### Lifetime Smoking

|                | FB 51.8% | CB 35.8% | CB 48.6% | CB 22.7% | CB 23.4% | CB 13.8% | CB 23.4% | CB 48.8% | CB 48.5% | CB 43.3% | CB 67.2% |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| ≥100 cigarettes | 48.2%    | 64.2%    | 51.4%    | 77.3%    | 76.6%    | 86.2%    | 76.6%    | 51.2%    | 51.5%    | 56.7%    | 32.8%    |
| <100 cigarettes | 96.2%    | 94.6%    | 95.9%    | 91.3%    | 89.8%    | 89.8%    | 89.0%    | 89.0%    | 96.2%    | 94.6%    | 95.9%    |

### Past-year GP contact

|                | FB 84.2% | CB 82.4% | CB 85.3% | CB 82.2% | CB 84.9% | CB 75.9% | CB 73.9% | CB 70.0% | CB 72.6% | CB 84.6% | CB 85.5% |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Have contact   | 12.0%    | 11.5%    | 11.2%    | 10.3%    | 9.1%     | 13.4%    | 10.1%    | 20.0%    | 20.8%    | 12.5%    | 10.0%    |
| No contact     | 3.8%     | 6.1%     | 3.6%     | 7.4%     | 6.0%     | 10.7%    | 15.9%    | 10.0%    | 6.5%     | 2.9%     | 4.5%     |
| No answer      | 96.2%    | 94.6%    | 95.9%    | 91.3%    | 89.8%    | 89.8%    | 89.0%    | 89.0%    | 96.2%    | 94.6%    | 95.9%    |

### Cumulative profile

|                | FB 69.8% | CB 75.7% | CB 73.7% | CB 76.9% | CB 0.0%  | CB 0.0%  | CB 71.0% | CB 62.4% | CB 62.1% | CB 73.3% | CB 0.0%  |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 vulnerability | 30.2%    | 24.3%    | 26.3%    | 23.1%    | 69.8%    | 62.5%    | 29.0%    | 37.6%    | 37.9%    | 26.7%    | 70.4%    |
| 1 vulnerability | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     |
| 2 vulnerabilities | 0.0%    | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     |
| 3 vulnerabilities | 0.0%    | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     | 0.0%     |

### Medical conditions

|                | FB 36.6% | CB 39.7% | CB 37.7% | CB 59.1% | CB 32.6% | CB 27.7% | CB 46.0% | CB 41.2% | CB 52.4% | CB 34.6% | CB 27.0% |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 0 risk         | 49.7%    | 50.2%    | 49.0%    | 36.0%    | 52.7%    | 58.0%    | 40.9%    | 50.0%    | 38.1%    | 53.8%    | 53.7%    |
| 1 or 2 risks   | 13.7%    | 10.2%    | 13.3%    | 5.0%     | 14.8%    | 14.3%    | 13.1%    | 8.8%     | 9.5%     | 11.5%    | 19.3%    |
| ≥3 risks       | 13.7%    | 10.2%    | 13.3%    | 5.0%     | 14.8%    | 14.3%    | 13.1%    | 8.8%     | 9.5%     | 11.5%    | 19.3%    |

Notes: FB=Foreign-born; CB=Canadian-born. All differences by race-nativity status reached the 0.05 level of statistically significance in the chi-square test (p<0.05). ADLs= Activities of Daily Living.
Table 2 Weighted prevalence and adjusted odds ratios of medical conditions as risk factors of severe COVID-19 illness by upstream social determinants of health and covariates in the CLSA, persons aged 45–85 years (n=29,748)

| Variables                      | Unwtg. Total N | 1 or 2 risk (n=15,215) (vs. 0 risk) | ≥ 3 risks (n=5,033) (vs. 0 risk) |
|--------------------------------|----------------|-------------------------------------|----------------------------------|
|                                | wtg. % OR 95%CI| p-value wtg. % OR 95%CI p-value     |                                  |
| Nativity/Race (Ref. CB White)  |                |                                    |                                  |
| FB Black                       | 200            | 58.0% 1.74 1.27 2.37 0.001          | 14.3% 1.79 1.13 2.82 0.013       |
| Aboriginals                    | 338            | 53.7% 1.52 1.16 1.99 0.002          | 19.3% 1.96 1.37 2.80 0.000       |
| FB South Asian                 | 268            | 52.7% 1.28 0.99 1.66 0.065          | 14.8% 1.49 1.02 2.19 0.039       |
| Other immigrants               | 102            | 53.8% 1.27 0.82 1.95 0.280          | 11.5% 1.06 0.53 2.11 0.877       |
| CB non-White                   | 242            | 50.2% 1.09 0.85 1.39 0.520          | 10.2% 1.04 0.68 1.59 0.865       |
| FB Latin American              | 119            | 50.0% 1.05 0.76 1.45 0.775          | 8.8% 0.77 0.43 1.38 0.377        |
| FB White                       | 4264           | 49.0% 0.88 0.82 0.95 0.001          | 13.3% 0.83 0.74 0.93 0.001       |
| FB Southeast Asian             | 114            | 40.9% 0.71 0.49 1.03 0.071          | 13.1% 0.99 0.57 1.72 0.970       |
| FB West Asian                  | 126            | 38.1% 0.63 0.45 0.88 0.007          | 9.5% 0.65 0.37 1.15 0.137        |
| FB East Asian                  | 173            | 36.0% 0.52 0.39 0.68 <0.001         | 5.0% 0.31 0.17 0.57 <0.001       |
| Family Income (Ref. ≥$150k)    |                |                                    |                                  |
| < $20k                         | 1533           | 47.8% 1.14 0.96 1.34 0.127          | 27.0% 2.44 1.96 3.04 <0.001      |
| $20k to <$50k                  | 6271           | 53.0% 1.22 1.11 1.34 <0.001         | 20.1% 1.94 1.67 2.26 <0.001      |
| $50k to <$100k                 | 9791           | 49.3% 1.01 0.94 1.09 0.773          | 14.8% 1.53 1.35 1.75 <0.001      |
| $100k to <$150k                | 5461           | 49.0% 1.02 0.94 1.10 0.705          | 9.2% 1.17 1.01 1.35 0.033        |
| No answer                      | 1912           | 49.8% 0.96 0.84 1.09 0.496          | 15.6% 1.41 1.16 1.72 0.001       |
| Education (Ref. Post-secondary)|                |                                    |                                  |
| <secondary school              | 1621           | 51.9% 1.45 1.25 1.68 <0.001         | 28.7% 2.10 1.76 2.50 <0.001      |
| Secondary school               | 2812           | 51.2% 1.11 1.01 1.22 0.029          | 16.6% 1.21 1.06 1.38 0.004       |
| Some post-secondary            | 2210           | 53.3% 1.33 1.19 1.48 <0.001         | 17.7% 1.53 1.32 1.78 <0.001      |
| No answer                      | 46             | 46.3% 0.95 0.45 2.02 0.891          | 24.4% 1.26 0.51 3.14 0.621       |
| Age (Ref. 45-55)               |                |                                    |                                  |
| 56-65                          | 9762           | 49.9% 1.35 1.26 1.44 <0.001         | 14.9% 2.38 2.13 2.65 <0.001      |
| 66-75                          | 7266           | 52.8% 1.77 1.61 1.95 <0.001         | 21.4% 3.72 3.23 4.30 <0.001      |
| 76-85                          | 5204           | 58.7% 2.78 2.46 3.14 <0.001         | 24.1% 5.40 4.57 6.37 <0.001      |
| Gender (Ref. Female)           | 15161          | 49.0% 1.00                           | 13.2% 1.00                       |
| Variable                                      | N   | Male (%) | OR   | 95% CI  | P-value |
|-----------------------------------------------|-----|----------|------|---------|---------|
| Male                                          | 14587 | 50.2%   | 1.23 | 1.17    | <0.001  |
| Relationship (Ref. Married)                   | 20446 | 49.3%   | 1.00 | 1.00    |         |
| Single/separated                              | 9302  | 50.3%   | 1.04 | 0.97    | 0.124   |
| Chronic pain (Ref. No pain)                   | 22322 | 49.2%   | 1.00 | 1.00    |         |
| Have chronic pain                             | 6007  | 51.0%   | 1.53 | 1.42    | <0.001  |
| No answer                                     | 1419  | 49.2%   | 0.98 | 0.65    | 0.935   |
| ADLs disability (Ref. no/mild)                | 29282 | 49.6%   | 1.00 | 1.00    |         |
| ADLs severe disability                        | 363   | 44.7%   | 1.22 | 0.88    | 0.267   |
| Assessment not complete                       | 103   | 54.3%   | 1.41 | 0.91    | 0.127   |
| Retirement status (Ref. No)                   | 13168 | 46.9%   | 1.00 | 1.00    |         |
| Completely retired                            | 16473 | 53.1%   | 1.12 | 1.04    | 1.20    | 0.003   |
| No answer                                     | 107   | 48.2%   | 0.85 | 0.56    | 1.29    | 0.447   |
| Lifetime Smoking (Ref. <100)                  | 14111 | 48.8%   | 1.00 | 1.00    |         |
| ≥100 cigarettes                               | 15637 | 50.3%   | 1.14 | 1.08    | 1.20    | <0.001  |
| Past-year GP contact (Ref. No)                | 2796  | 40.7%   | 1.00 | 1.00    |         |
| Have past-year GP contact                     | 25606 | 50.8%   | 1.72 | 1.59    | 1.85    | <0.001  |
| No answer                                     | 1346  | 49.8%   | 2.02 | 1.33    | 3.08    | 0.001   |
| Cumulative profile (Ref. 0)                   | 19115 | 48.5%   | 1.00 | 1.00    |         |
| 1 vulnerability (R/E/I)                       | 10336 | 51.8%   | 1.25 | 1.18    | 1.33    | <0.001  |
| 2 vulnerabilities (R+E/R+I/E+I)               | 243   | 54.9%   | 1.89 | 1.36    | 2.63    | <0.001  |
| 3 vulnerabilities (R+E+I)                     | 54    | 48.8%   | 1.63 | 0.74    | 3.59    | 0.221   |

Notes: FB=Foreign-born; CB=Canadian-born; Unwtg.= Unweighted; Wtg.=Weighted; OR=odds ratio; 95%CI=95% Confidence Interval; GP=general practitioners; ADLs=Activities of Daily Living Scales; Statistics for multinominal logistic regression that reach the 0.05 level of significance are bolded (Nagelkerke R^2 = 0.14). Cumulative profile was tested in a separated identical analysis adjusted for same covariates (not shown; Nagelkerke R^2 = 0.13). Cumulative profile=a sum of three social positions (R=South Asian, Black or Aboriginals; and/or I=household income <$50k; and/or E=≤ high school graduates).
Figure 1 Weighted prevalence of 9 specific medical conditions as risk factors of severe COVID-19 illness by race-nativity status in the CLSA, persons aged 45–85 years (n=29,748)

| Condition                | Total sample | Aboriginals | FB South Asian | FB Black | CB White | FB White | FB Southeast Asian | CB non-White | FB West Asian | FB Latin American | FB East Asian |
|--------------------------|--------------|-------------|----------------|----------|----------|----------|-------------------|-------------|--------------|------------------|---------------|
| Morbidity ≥ 3 diseases   | 13.60%       | 19.3%       | 14.8%          | 14.3%    | 13.7%    | 13.3%    | 13.1%            | 10.2%       | 9.5%         | 8.8%             | 5.0%          |
| Hypertension             | 32.1%        | 32.2%       | 34.0%          | 44.6%    | 32.0%    | 32.8%    | 36.2%            | 34.6%       | 21.3%        | 18.9%            | 21.9%         |
| Obesity                  | 27.5%        | 40.3%       | 19.9%          | 37.5%    | 28.2%    | 25.5%    | 13.8%            | 18.0%       | 23.4%        | 23.1%            | 3.3%          |
| Diabetes                 | 15.4%        | 26.2%       | 31.2%          | 18.5%    | 15.0%    | 15.3%    | 20.3%            | 18.2%       | 14.9%        | 17.9%            | 13.2%         |
| Asthma                   | 13.6%        | 21.9%       | 14.7%          | 10.7%    | 13.8%    | 11.7%    | 11.6%            | 13.9%       | 8.9%         | 16.5%            | 12.8%         |
| Cancer                   | 12.5%        | 7.4%        | 5.4%           | 7.1%     | 12.7%    | 14.7%    | 4.3%             | 8.4%        | 7.7%         | 3.5%             | 5.0%          |
| COPD                     | 4.8%         | 9.0%        | 2.7%           | 0.9%     | 4.9%     | 4.6%     | 0.7%             | 4.8%        | 2.4%         | 1.8%             | 4.1%          |
| Heart Attack             | 3.6%         | 1.9%        | 5.1%           | 0.9%     | 3.7%     | 3.7%     | 2.9%             | 2.9%        | 5.9%         | 2.4%             | 2.1%          |
| Angina                   | 3.5%         | 2.9%        | 6.4%           | 3.1%     | 3.6%     | 3.7%     | 2.9%             | 2.9%        | 5.9%         | 2.4%             | 0.4%          |
| Kidney disease           | 2.6%         | 2.3%        | 1.7%           | 2.7%     | 2.5%     | 2.7%     | 4.3%             | 2.9%        | 4.3%         | 2.9%             | 1.7%          |

Notes: FB=Foreign-born; CB=Canadian-born; CLSA= Canadian Longitudinal Study on Aging (baseline comprehensive cohort). COPD=chronic obstructive pulmonary disease. All differences by race-nativity status reached the 0.05 level of statistically significance in the chi-square test (p<0.05), except for kidney disease (p=0.30) and heart attack (p=0.12).

*P <0.05; **P <0.01; ***P <0.001; ns=not significant. Multimorbidity: having ≥ 3 medical conditions (risks).
Figure 2 Weighted prevalence and adjusted odds ratios of multiple medical conditions as risk factors of severe COVID-19 illness by race/nativity, income, education and cumulative profile (n=29,748)

Notes: FB=Foreign-born; CB=Canadian-born; 95%CI=95% Confidence Interval; Risk factors=underlying medical conditions. Odds ratio (ORs) was adjusted for age, sex, marital status, retirement status, chronic pain, smoking, physical impairment, and health care use. Ref=reference group. ORs were considered to be statistically significant when 95%CI did not overlap with 1.0. Cumulative profile=a sum of three social positions (South Asian, Black or Aboriginals; and/or household income <$50k; and/or ≤ high school graduates).