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Trends in obesity and multimorbidity in Canada

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ABSTRACT

Very few studies have examined trends in multimorbidity over time and even fewer have examined trends over time across different body mass index (BMI) groups. Given a general decline in death rates but increased cardiovascular risk factors among individuals with obesity, the trend in the association between obesity and multimorbidity is hypothesized to be increasing over time. The data for our study came from the 1996–97 National Population Health Survey and the 2005 and 2012–13 Canadian Community Health Surveys (N = 277,366 across all 3 surveys). We examined trends in the association between BMI groups and multimorbidity using a logistic regression model. We also investigated trends in the prevalence of specific chronic conditions, pairs of chronic conditions and different levels of multimorbidity across BMI groups. We found significantly greater levels of multimorbidity in 2005 (OR = 1.42; $p < 0.001$) and 2012–13 (OR = 1.58; $p < 0.001$) relative to 1996–97. Changes in multimorbidity levels were much greater among individuals with class II/III (OR = 1.48; p = 0.005) and class I obesity (OR = 1.38; p = 0.001) in 2012–13 relative to 1996–97. Much of the increase in multimorbidity among individuals living with obesity was due to increases in 3+ chronic conditions and conditions in combination with hypertension, and the greatest increase was found among seniors living with obesity. Our results highlight the need for interventions aimed at preventing obesity and the prevention of chronic conditions among individuals with obesity, especially among seniors.

1. Introduction

In recent decades, the prevalence of obesity has risen considerably across the developed world (Ng et al., 2014). This has been alarming given the association between obesity and numerous chronic conditions, including type II diabetes, hypertension, heart disease, osteoarthritis, and numerous cancers (Guh et al., 2009). Not surprisingly, obesity is associated with an elevated risk of mortality, disability (Reuser et al., 2009), and reduced health related quality of life (Jia and Lubetkin, 2005). Obesity places a significant financial burden on health care systems throughout the developed world (Kim and Basu, 2016; Anis et al., 2010).

We are witnessing a change in the risks of mortality and the burden of diseases across various populations. In the United States (US), the mortality risks associated with obesity have been declining (Flegal et al., 2007), likely due to better management of cardiovascular risk factors and declining cardiovascular related mortality. There has been increasing prevalence of severe obesity (i.e. class II (35 ≤ body mass index (BMI) ≤ 40) and class III (BMI > 40) obesity) and increasing non-mortality burden of disease among individuals with obesity, including stronger associations with diabetes, arthritis and disability (Peeters and Backholer, 2012). In Canada, there have been parallel improvements in the treatment of cardiovascular risk factors such as hypertension (McAlister et al., 2009) and high cholesterol (Neutel et al., 2007), and decreases in deaths due to cardiovascular disease (Tu et al., 2009). Meanwhile, there have also been increases in severe obesity (Katzmarzyk and Mason, 2006) and in the prevalence of cardiovascular risk factors such as diabetes and hypertension (Lee et al., 2009).

These changes in survival and population aging are likely contributing to a greater prevalence of multimorbidity, defined as the presence of two or more chronic conditions in the same individual. The prevalence of multimorbidity is rising in the United States (Paez et al., 2009), Canada (Pefoyo et al., 2015), England (Dhalwani et al., 2016), Germany (Tetzlaff et al., 2017), and the Netherlands (Uijen and van de Lisdonk, 2008). Although obesity is associated with a greater levels of multimorbidity (Agborsangaya et al., 2013; Booth et al., 2014), to what

Abbreviations: BMI, Body mass index; NPHS, National Population Health Survey; CCHS, Canadian Community Health Surveys; COPD, Chronic obstructive pulmonary disease; OR, Odds ratio

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extent obesity is contributing to the rise in multimorbidity across countries is unclear given that there have been few studies examining trends in multimorbidity over time; even fewer studies have examined the trends in multimorbidity with respect to obesity (Canizares et al., 2018). Examining these trends are important for identifying the population health status of individuals with and without obesity over time. If obesity is contributing to the rise in multimorbidity, this suggests potential intervention strategies targeting specific chronic conditions and/or specific populations.

Therefore, our objective was to examine the prevalence of multimorbidity over time by BMI groups and the relationship between obesity and multimorbidity over time in Canada. Our hypothesis was that the trends in the association between obesity and multimorbidity have been increasing over time. Our secondary objectives were to examine specific chronic conditions, chronic disease combinations, and severity of multimorbidity (i.e. presence of three or more conditions) over time by BMI groups to help inform which conditions can be targeted to reduce the burden of multimorbidity.

2. Materials and methods

2.1. Data

We analysed the relationship between obesity and multimorbidity using pooled cross-sectional survey data. We used the 1996–97 National Population Health Survey (NPHS), and the 2005 and 2012–13 Canadian Community Health Surveys (CCHS). These cross-sectional surveys were conducted by Statistics Canada using computer assisted interview methods and multi-stage stratified cluster sampling designs; details of the survey design can be found elsewhere (Tambay and Catlin, 1995; Béland, 2002). Each survey asked questions ascertaining height and weight, chronic conditions, and a rich set of sociodemographic and lifestyle characteristics. All surveys are nationally representative, have large sample sizes, have nearly identical sample inclusion and exclusion criteria, and identical or very similar questions asked on each of the included variables. All surveys excluded full-time members of Canadian Forces and residents of Indian Reserves, Crown Lands, institutions and certain remote regions. We excluded respondents who were < 18 years of age at the time of interview, residents of the three Canadian Territories, pregnant women, and individuals who had missing data on BMI.

2.2. Outcomes

Individuals were classified as having multimorbidity if they reported having at least two chronic conditions among a list of conditions commonly included in studies of multimorbidity and available in all survey periods (Prados-Torres et al., 2014; Willadsen et al., 2016). Our list included ten such conditions: asthma, arthritis, high blood pressure, diabetes, heart disease, cancer, stroke, chronic obstructive pulmonary disease (COPD), and Alzheimer's disease and dementia. COPD and dementia were only available among adults aged 35+ due to the design of the surveys.

2.3. Exposures

All variables were derived from self-reported responses to the survey questions. BMI was defined as weight (kg)/height (m^2). We categorized BMI into underweight (BMI < 18.5), normal weight (18.5 ≤ BM < 25), overweight (25 ≤ BMI < 30), class I obesity (30 ≤ BMI < 35), and severe or class II/III obesity (35 ≤ BMI).

We controlled for age, sex, marital status, immigrant status, home ownership, rural residence, education, income quintile, smoking status, and alcohol consumption in all multivariable logistic regressions. Age and age squared were included to capture a quadratic relationship of an outcome variable with respect to age. Marital status was defined as married, single, and divorced/separated/widowed. We identified individuals as recent immigrants (i.e. < 10 years in Canada), long-term immigrant (i.e. ≥10 years), or non-immigrants. We derived educational status based on the highest degree completed by the respondent at the of survey interview. We generated household income quintiles where income was adjusted by the square root of the number of the people in the household (Murphy et al., 2010). We categorized smoking status into never smoker, former smoker, or current smoker. Alcohol consumption was categorized as none in the prior 12 months, occasional (drink alcohol < 1 time per month) or regular drinkers.

2.4. Statistical analysis

We used unadjusted logistic regression models to analyze trends in multimorbidity and chronic condition combinations and used multivariable logistic regression to assess the relationship between obesity and multimorbidity. In order to examine trends over time and test for statistical significance of any changes in the relationship between obesity and each outcome, we pooled all surveys and included an interaction between BMI category and survey year. We assessed the prevalence of each chronic condition and of the 10 most prevalent disease pairs among all individuals as well as normal weight individuals and individuals with obesity in 1996–97 and 2012–13. In 1996–97 and 2012–13, we assessed the prevalence of 0, 1, 2, and 3+ chronic conditions among all BMI groups, overall and by age group (< 45, 45–64, 65+). We used survey and bootstrap weights provided by Statistics Canada in all analyses in order to produce nationally representative estimates and account for the complex survey design features in variance estimation. A binary indicator was included for the respondents with missing income, while a small proportion of respondents with missing data (3.8%) on all other variables were excluded from the analysis. We conducted all analyses with Stata vs.14.

3. Results

From an initial 81,804, 132,947, and 126,449 respondents available in three cross-sectional surveys, a total of 64,904, 114,301 and 109,095 respondents met the inclusion criteria in 1996–97, 2005 and 2012–13, respectively, yielding a total sample size of 288,300 for our analysis. There was a minimal missing data: a total of 10,934 (3.8%) respondents missing on all other variables who were excluded from the analyses. A total of 25,164 (8.7%) respondents were missing on income and were included in the analysis using a binary indicator for missing. The prevalence of class I obesity increased by 35.1% from 9.7% in 1996–97 to 13.1% in 2012–13 and class II/III obesity increased by 112% from 2.6% in 1996–97 to 5.5% in 2012–13. The prevalence of obesity was 18.6% in 2012–13. Other descriptive characteristics of the samples are reported in Table 1.

The prevalence of multimorbidity in the population and across BMI groups is shown in Fig. 1. The prevalence of multimorbidity significantly increased across surveys both overall (OR = 1.42; $p < 0.001$ for 2005 vs. 1996–97; OR = 1.58; $p < 0.001$ for 2012–13 vs. 1996–97) and across all BMI groups (OR = 1.36–1.65, all $p < 0.001$ for 2012–13 vs. 1996–97) except for the underweight group. Individuals with class II/III obesity experienced the largest increase in multimorbidity (OR = 1.65; $p < 0.001$ for 2012–13 vs. 1996–97).

The results of logistic regression results are reported in Table 2. The omnibus test was significant for multimorbidity ($p < 0.05$), therefore BMI group and time (i.e. survey year) interaction terms were included in the analysis. Multimorbidity among normal weight individuals was significantly greater in 2005 (OR = 1.22; $p < 0.001$) and 2012–13 (OR = 1.15; $p = 0.013$) relative to 1996–97. Both class I (OR = 2.30; $p < 0.001$) and class II/III obesity (OR = 3.91; $p < 0.001$) were positively associated with multimorbidity and these associations were significantly greater in the later time periods relative to 1996–97 (OR for class II/III obesity × 2012–13 interaction = 1.48; $p = 0.005$).

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