

## Worsening Obesity Across Canada and Concerns for COVID-19 Pandemic Severity

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## Abstract

### Background

Our study analyzed and described national and provincial/territorial obesity trends in the Canadian adult population from 2005 through 2017-18, to understand potential implications of obesity trends on the COVID-19 pandemic.

### Methods

Data from 746,408 Canadian Community Health Survey (CCHS) adult survey participants (403,582 females and 342,826 males) were obtained from seven consecutive cycles (CCHS<sub>2005</sub> – CCHS<sub>2017-18</sub>). Obesity prevalence (adjusted BMI $\geq$ 30.00 kg/m<sup>2</sup>) was a primary outcome variable. Obesity rates across CCHS cycles and trends over time were analyzed using Pearson's chi-squared test with Bonferroni's p-value adjustment, and Cochran-Armitage test of trend. P-value $\leq$ 0.05 indicated statistical significance.

### Results

Canada-wide obesity prevalence increased significantly between 2005 and 2017-18, from 22.2% to 27.2% (p<0.001). Increases were observed across both sexes, all age groups, and all Canadian provinces/territories (p<0.001). In 2017-18, obesity prevalence was higher among males than females (28.9% vs. 25.4%; p<0.001); Canadian adults in their 60s, 50s and 40s had obesity prevalence exceeding 30%. In 2017-18, Newfoundland and Labrador had the highest (39.4%), and British Columbia – the lowest (22.8%) obesity rate. Over 14 years, Quebec and Alberta exhibited the largest relative increases in obesity.

### Interpretation

In 2017-18, approximately 1 in 4 adult Canadians lives with obesity, the highest-ever rate. With obesity identified as a key risk factor for COVID-19 infection acquisition, morbidity and mortality, these trends may be contributing to the severity of the COVID-19 pandemic in Canada. Our findings call for urgent actions to identify, develop, implement and evaluate solutions for obesity prevention

and management in all Canadian provinces and territories.

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## Introduction

Currently, the world including Canada finds itself within a coronavirus disease (COVID-19) pandemic and pandemic-related impacts on health, well-being, healthcare and economy <sup>1</sup>. Much attention has rightly focused on attempts to mitigate negative impacts and control the infection. Underlying conditions such as obesity and chronic diseases have now been identified as key risk factors for acquisition and severity of COVID-19 infection including hospitalizations, ICU admissions and death <sup>2-11</sup>.

According to WHO, obesity continues to advance across every region and socioeconomic class and becomes a global epidemic with over 13% of adults worldwide affected <sup>12</sup>. Obesity is a progressive, multifactorial, chronic disease with high risks of relapse and recurrence <sup>13</sup>. Up to 12.0% of Canadian health expenditures are attributed to obesity; annual costs exceed 11 billion dollars <sup>14</sup>. It is a major cause of multiple comorbidities, including type II diabetes, cardiovascular diseases, nonalcoholic fatty liver disease, osteoarthritis, chronic kidney disease, chronic back pain, and many cancer types, many of which also increase morbidity and mortality risks from COVID-19 <sup>15-22</sup>.

Canadian population-wide adult obesity trend studies using multiple consecutive cross-sectional surveys at national/provincial/territorial levels are scarce, outdated, and do not include data from multiple consecutive years and trend analyses <sup>23-28</sup>. Exploring the prevalence and trends of obesity may assist in our understanding of the potential severity of COVID-19 morbidity and mortality within our population. In our study, the aim was to describe and analyze obesity trends at national and provincial/territorial levels in the adult Canadian population from 2005 through 2017-18 and discuss potential implications for the COVID-19 pandemic.

## Methods

### *Study design*

Data were obtained from seven consecutive cycles of the Canadian Community Health Survey (from CCHS<sub>2005</sub> to CCHS<sub>2017-18</sub>) <sup>29-35</sup>. CCHS is a Canada-wide cross-sectional survey with a complex,

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2  
3 multistage, multi-frame, stratified sampling design that collects information related to health status,  
4 healthcare utilization and health determinants from a large national sample of survey respondents to  
5 provide estimates for the whole Canadian population <sup>36</sup>. The CCHS targets persons aged 12 years  
6 and older who are living in private dwellings in the ten provinces and three territories. Persons living  
7 on Indian Reserves or Crown lands, those residing in institutions, full-time members of the Canadian  
8 Forces and residents of certain remote regions are excluded from this survey. The CCHS covers  
9 approximately 98% of the Canadian population aged 12 and older <sup>36</sup>. Further details about CCHS  
10 methodology are found elsewhere <sup>36</sup>. The eligibility criteria for our study participants included: being  
11 an adult ( $\geq 18$  y.o.) participant in at least one of the seven consecutive CCHS cycles, with BMI values  
12 available. Our study design and step-by-step methodological approach are presented in Fig. 1. The  
13 variables used in this study consisted of sex and age, province of residence and BMI. Sex-specific  
14 correction equations developed by *Gorber* and colleagues (*Reduced model 4* as recommended)  
15 were applied to self-reported BMI to produce adjusted BMI estimates which yield estimates  
16 maximally in line with measured ones <sup>37-39</sup>. Adjusted BMI (a number with two decimals) was further  
17 used to categorize individuals into corresponding weight status categories <sup>40-42</sup>.

### 34 *Primary outcome*

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36 Obesity prevalence was the primary outcome variable. Individuals were defined as being obese with  
37 an adjusted BMI of 30.00 kg/m<sup>2</sup> or higher.  
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### 41 *Statistical analysis*

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43 For statistical estimates produced from the CCHS data to be accurate and representative of the  
44 Canadian population and not just the sample, standardized survey weights were incorporated in  
45 calculations and applied before statistical analyses were performed <sup>43</sup>. Categorical data were  
46 presented as proportions and counts. Comparisons of obesity prevalence rates across CCHS cycles  
47 were performed using two-tailed Pearson's chi-squared test and post-hoc paired comparisons on  
48 each pair of CCHS cycles with p-value adjustment according to the Bonferroni method for multiple  
49 pairwise comparisons. Trends in obesity prevalence over time were analyzed using the Cochran-  
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3 Armitage test of trend. All statistical analyses and data visualization were performed using SPSS  
4 23.0, GraphPad Prism 6.0, and Tableau Public 2020.3, with a  $p\text{-value}\leq 0.05$  indicating statistical  
5 significance<sup>44–46</sup>.  
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### 10 *Ethics approval*

11  
12 Our study was exempt from need for the University of Alberta Research Ethics Board review as  
13 CCHS Public use microdata files (PUMFS) produced by Statistics Canada are publicly accessible  
14 via the Data Liberation Initiative.  
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### 20 **Results**

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22 Our study sample consisted of 746,408 CCHS survey respondents (403,582 females and 342,826  
23 males). Main demographic characteristics of the study participants are presented in Table 1.  
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25 Individuals in their 50s had the largest share in the study population compared to other age  
26 categories for the first three CCHS cycles, shifting to older groups in their 60s later, mirroring aging  
27 of the Canadian population. Geographic area distributions were consistent throughout cycles.  
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34 In 2005, Canada-wide obesity prevalence was 22.2% and over 14 years increased significantly  
35 reaching the ever-highest level of 27.2% in 2017-18;  $p<0.001$  (Table 2; Fig. 5). Obesity prevalence  
36 rates had been rising gradually demonstrating stepwise temporal patterns.  
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41 Obesity prevalence in 2005 among males was substantially higher than in females (24.0% vs.  
42 20.4%;  $p<0.001$ ). Over the following 14 years, obesity rates increased in both sexes, with females  
43 experiencing a larger increase. By 2017-18, the obesity rate among males continued to be  
44 significantly higher in comparison to females (28.9% vs. 25.4%;  $p<0.001$ ) (Table 2; Fig. 2).  
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51 Age-wise, in 2005, adults in their 60s and 50s had the highest obesity rates, followed by adults in  
52 their 40s (28.0%, 27.8%, and 23.8% respectively). Over the next 14 years, obesity rates rose  
53 significantly in all age groups with the largest increase among people in their 40s ( $p<0.001$ ). By  
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3 2017-18, obesity rates among Canadians in their 60s, 50s, and 40s were 32.3%, 31.4%, and 30.9%,  
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5 respectively (Table 2; Fig. 3).  
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9 In 2005, British Columbia and Quebec had the lowest obesity prevalence (19.2% and 20.1%,  
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11 respectively) while Newfoundland and Labrador New Brunswick and Prince Edward Island had the  
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13 highest rates of 33.5%, 30.9% and 30.1%, respectively. All provinces and territories showed  
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15 increases in obesity prevalence from 2005 to 2017-18 ( $p < 0.001$ ), with the highest rate remaining in  
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17 Newfoundland and Labrador at 39.4% and the lowest rate in British Columbia at 22.8%. Over the 14  
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19 years, Quebec and Alberta demonstrated the largest relative increases in obesity prevalence (Table  
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21 2; Fig. 4-6). There were statistically significant differences in obesity prevalence across CCHS cycles  
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23 for both sexes, all age categories, and at national and provincial/territorial levels ( $p < 0.001$ ). Findings  
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25 of subsequent pairwise comparisons were consistent with obesity rates being markedly different  
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27 between each CCHS cycle Canada-wide ( $p < 0.001$ ). In 2017-18, sex-specific, age-specific, and  
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29 national and provincial/territorial obesity rates were significantly higher compared to those in 2005  
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31 ( $p < 0.001$ ). Furthermore, from 2005 through 2017-18, there was a statistically significant increasing  
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33 linear trend in obesity prevalence in both sexes, all age groups, Canada-wide, and in all  
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35 provinces/territories (Cochran-Armitage test of trend,  $p < 0.001$ ) (Table 2; Fig. 2-4).  
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### 38 **Interpretation**

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40 Our study findings demonstrate that adult obesity prevalence in Canada increased from 22.2% in  
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42 2005 to 27.2% in 2017-18, the highest-ever rate. This trend was observed across sexes, various age  
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44 categories, all provinces and territories. Those tendencies are comparable with global data and other  
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46 high-income English-speaking countries, reflecting consistently increasing trends in obesity  
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48 prevalence worldwide <sup>47-49</sup>.  
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52 No prior Canada-wide analyses of obesity prevalence have been performed for the period from 2005  
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54 through 2017-18, the latest nationwide data available. The previous peer-reviewed publication  
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56 comparing obesity prevalence between non-consecutive CCHS cycles was based on data up to  
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3 2013<sup>28</sup>. We analyzed data from seven consecutive CCHS cycles, representing the most  
4 comprehensive trend analyses to our knowledge. Additionally, we applied well-defined and robust  
5 methodological processes: defined explicit inclusion/exclusion criteria, included the 18-19 year-old  
6 age category, did not exclude the underweight category from analyses, re-derived weight categories  
7 based on two-decimal point BMI value to improve precision, and used correction equations.  
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9 Therefore, it is challenging to directly compare our findings with the results of other studies.  
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17 Trajectory of obesity trends in Canada nationally and across provinces/territories is increasing  
18 alarmingly. In our study, obesity trends in Canada are explored to gain some understanding of  
19 potential implications for the current COVID-19 pandemic. There is overwhelming evidence that  
20 obesity is a key risk factor for the acquisition of COVID-19 infection and a strong predictor of its  
21 adverse outcomes. Obesity was deemed to be associated with an up to 2.1-fold higher risk for  
22 severe COVID-19 infection, 2.4-fold – for hospitalization, 5.3-fold – for ICU admission, 7.4-fold – for  
23 invasive mechanical ventilation support, and 2.7-fold higher risk for mortality<sup>2-11</sup>. A recent meta-  
24 analysis has also demonstrated a linear relationship between BMI and COVID infection severity and  
25 mortality<sup>5</sup>. In the context of the COVID-19 pandemic, obesity trends seen in Canada are potentially  
26 presenting important risks and challenges regarding infection acquisition, severity and mortality.  
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38 Recent meta-analyses suggest that male sex is an independent risk factor for severe COVID-19  
39 infection, ICU admission and death with odds reaching as high as 2.84 compared to females<sup>50,51</sup>.  
40 The male population in Canada is also characterized by higher rates of smoking and underlying  
41 diseases, such as diabetes, hypertension and COPD, with those factors independently at least  
42 doubling the risk for severe and morbid COVID-infection<sup>4,50,52-57</sup>. Coupled with the higher  
43 prevalence of obesity among males demonstrated in our study it poses a significant concern that  
44 cannot be disregarded.  
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53 In multiple studies across the world, age has been repeatedly identified as a major risk factor for  
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3 progressively with age and reaching 1.3% and 3-5% among patients in their 50s and 60s,  
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5 respectively, in comparison to 0.4% among those in the 40s or younger <sup>58-63</sup>. Because every third  
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7 Canadian adult in their 50s and 60s lives with obesity, those age groups have the highest obesity  
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9 rates, it also creates significant challenges for preventing undesirable COVID-19 outcomes.  
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13 Future studies should model variations of COVID-19 outcomes among provinces with variations in  
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15 underlying chronic risk conditions, such as obesity and obesity-related chronic diseases at  
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17 population levels. Further studies are also needed for their effective prevention and management, for  
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19 example, by assessing temporal obesity patterns in the context of socio-demographic and  
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21 behavioural factors in Canada. It would also be important to evaluate intervention efforts among  
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23 physicians (in primary care, those specializing in obesity medicine, and specialists treating  
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25 comorbidities); public health professionals; various stakeholders at municipal/provincial/federal  
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27 levels including policymakers, urban planners and developers shaping community environments;  
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29 community organizations; the pharmaceutical industry; employers; academia; and those living with  
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31 obesity. In 2017, the Chief Public Health Officer of Canada released the report “Designing Healthy  
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33 Living” in a call to action to improve our community environments in support of healthy living <sup>64</sup>.  
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35 Implementing and evaluating innovative interventions already demonstrated to reverse longstanding  
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37 obesity trends at a population level should be a priority for all Canadian provinces/territories <sup>64,65,74-  
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39 79,66-73</sup>. For example, in Alberta, policy and environmental approaches that successfully reversed  
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41 childhood obesity trends and increased life expectancies from chronic diseases in New York in  
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43 2002-2013 are being developed and evaluated through the *Housing for Health* initiative funded by  
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45 the Public Health Agency of Canada <sup>80</sup>. Learning from the US experience, the University of Alberta’s  
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47 Public Health and Preventive Medicine Residency Program and patient-care partners are also  
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49 currently developing and piloting the first Obesity Medicine Fellowship Program in Canada.  
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## 51 **Limitations**

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53 Analyzing a series of cross-sectional studies does not assess for a definitive trend over time due to  
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55 the lack of a clear longitudinal component. Recall, selection, observer and social acceptability biases  
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3 along with weight stigma influence could also not be ruled out. BMI as a proxy of weight status does  
4 not take into consideration ethnicity, sex and body composition and can be an inaccurate marker of  
5 adiposity with high specificity, but low-to-moderate sensitivity<sup>81,82</sup>. Nevertheless, BMI is shown as a  
6 reliable standardized weight status measure at the population level<sup>81-86</sup>. The robustness of  
7 relationships between BMI, obesity-related comorbidities and mortality also reflects its high utility  
8 and reliability<sup>87</sup>. Tendency to under-report weight and over-report height, especially among obese  
9 people, youth and females can lead to underestimating obesity rates but helps avoid overestimation  
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along with weight stigma influence could also not be ruled out. BMI as a proxy of weight status does not take into consideration ethnicity, sex and body composition and can be an inaccurate marker of adiposity with high specificity, but low-to-moderate sensitivity<sup>81,82</sup>. Nevertheless, BMI is shown as a reliable standardized weight status measure at the population level<sup>81-86</sup>. The robustness of relationships between BMI, obesity-related comorbidities and mortality also reflects its high utility and reliability<sup>87</sup>. Tendency to under-report weight and over-report height, especially among obese people, youth and females can lead to underestimating obesity rates but helps avoid overestimation<sup>88-92</sup>. However, unless tendency to under-reporting and over-reporting varies over time, this should not impact temporal trends. Self-reported anthropometric measurements correlate strongly with measured ones and can be used in epidemiological studies<sup>93-96</sup>. To overcome potential divergence, we applied correction equations developed and utilized by Statistics Canada to self-reported BMI estimates to produce adjusted BMI estimates maximally in line with measured ones<sup>37-39</sup>.

## Conclusion

- Approximately 1 in 4 adult Canadians lives with obesity.
- Obesity rate among adult Canadians increased by 23% since 2005 and in 2017-18 was at the ever-highest level of 27.2%.
- Obesity prevalence increased across sexes, age groups, and all Canadian provinces and territories from 2005 to 2017-18.
- Obesity prevalence among males is substantially higher than in females, this pattern remains unchanged over the last 14 years.
- Canadian adults in their 60s, 50s and 40s continue having the highest obesity prevalence, exceeding 30%, with the latter group demonstrating the most prominent increase in the obesity rate.
- Newfoundland and Labrador had the highest rates of obesity in Canada in 2017-18, with almost 4 out of 10 residents living with obesity; British Columbia had the lowest rate of obesity in Canada, but nevertheless, at least every fifth person was affected.

- Quebec and Alberta have had the largest increases in obesity prevalence, with relative increases of almost 30% between 2005 and 2017-18.
- Population obesity trends are expected to increase the severity of COVID-19 infection burden, morbidity and mortality across Canada.
- We cannot afford to ignore increasing rates of obesity and obesity-related comorbidities and their negative impact on health and well-being of the current Canadian population and our future generations. Our findings highlight the urgent need to identify, develop, implement and evaluate solutions for obesity prevention and management in Canada as well as funding for such efforts.

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Table 1. Demographic characteristics of the study participants, by the CCHS cycle, from 2005 through 2017-18.

Parameter	2005		2007-08		2009-10		2011-12		2013-14		2015-16		2017-18	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
<b>Total study population</b>		115787		113322		106950		107691		110349		94316		97993
<b>Sex</b>														
Female	49.7	61970	50.0	61492	49.7	57993	49.9	59078	49.8	60648	49.7	50158	49.8	52243
Male	50.3	53817	50.0	51830	50.3	48957	50.1	48613	50.2	49701	50.3	44158	50.2	45750
<b>Age categories</b>														
18–19 y.o.	3.3	3840	3.2	3223	3.2	3319	3.0	3084	3.0	2973	3.1	1976	3.0	1756
20–29 y.o.	17.4	15961	17.4	13851	17.4	13934	17.5	13653	17.1	12703	16.1	10818	16.1	11174
30–39 y.o.	17.4	19321	17.5	17856	16.6	15438	16.6	14304	16.7	13752	17.5	14235	17.9	14802
40–49 y.o.	21.8	19756	20.8	18688	20.2	15680	18.4	14539	17.6	13116	17.4	13739	16.6	13757
50–59 y.o.	17.4	20487	18.5	21638	18.9	20124	19.1	20309	19.5	20835	18.8	17388	18.0	17250
60–69 y.o.	11.5	16788	12.0	18227	13.0	18927	14.3	21186	14.7	23596	15.5	18579	15.8	19877
70–79 y.o.	7.6	12758	7.4	12879	7.2	12521	7.4	13079	8.0	15186	8.3	11829	9.0	13069
≥ 80 y.o.	3.5	6876	3.2	6960	3.4	7007	3.6	7537	3.6	8188	3.3	5752	3.6	6308
<b>Provinces/Territories</b>														
Alberta	9.7	10151	10.3	10215	10.5	9924	10.9	9760	11.3	10434	11.6	11381	11.5	11732
British Columbia	13.3	13570	13.3	13718	13.4	12995	13.5	13418	13.3	13387	13.2	12419	13.2	13338
Manitoba	3.4	6353	3.3	6433	3.3	5837	3.4	5905	3.3	6337	3.3	4631	3.4	4719
New Brunswick	2.4	4512	2.3	4746	2.2	4215	2.2	4207	2.1	4279	2.1	2841	2.1	3182
Newfoundland and Labrador	1.7	3587	1.6	3481	1.5	3243	1.5	3074	1.5	3410	1.5	2729	1.5	2804
Nova Scotia	2.9	4442	2.9	4486	2.8	4048	2.8	4011	2.7	4548	2.7	4105	2.6	4174
Ontario	38.8	36578	39.0	38137	38.9	36418	38.7	36640	38.4	36566	38.3	28024	38.5	28585
Prince Edward Island	0.4	1751	0.4	2029	0.4	1612	0.4	1513	0.4	1695	0.4	1511	0.4	1653
Quebec	24.2	25980	23.9	20742	23.7	19862	23.6	20495	23.7	20675	23.8	20487	23.5	21447
Saskatchewan	2.9	6706	2.8	6633	2.8	6328	2.8	6132	2.9	6338	2.9	3970	2.9	4172
Yukon/Northwest Territories/Nunavut	0.3	2157	0.3	2702	0.3	2468	0.3	2536	0.3	2680	0.3	2218	0.3	2187

Notes: Data are based on weighted estimates

Table 2. Temporal dynamics in obesity, national and province/territory-specific estimates, adjusted, by the CCHS cycle, Canada, from 2005 through 2017-18.

Parameter	2005				2007-08				2009-10				2011-12				2013-14				2015-16				2017-18				p-value, Pearson chi-square test	p-value, Cochran-Armitage test of trend
	%	n	95% CI		%	n	95% CI		%	n	95% CI		%	n	95% CI		%	n	95% CI		%	n	95% CI		%	n	95% CI			
			Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound		
<b>Canada-wide, all sexes and ages</b>	<b>22.2</b>	<b>28557</b>	22.17	22.21	<b>23.4</b>	<b>30267</b>	23.36	23.39	<b>24.0</b>	<b>29148</b>	23.97	24.00	<b>25.0</b>	<b>30287</b>	25.01	25.05	<b>26.3</b>	<b>32576</b>	26.33	26.36	<b>26.6</b>	<b>28335</b>	26.54	26.57	<b>27.2</b>	<b>30290</b>	27.14	27.17	<b>&lt;0.001</b>	<b>&lt;0.001</b>
<b>Sex-specific estimates</b>																														
Females	20.4	14652	20.38	20.42	21.7	15710	21.70	21.75	22.0	15081	21.97	22.02	23.2	15842	23.17	23.21	23.9	16984	23.87	23.92	24.3	14281	24.26	24.31	25.4	15403	25.40	25.45	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Males	24.0	13905	23.93	23.98	25.0	14557	25.01	25.06	26.0	14067	25.93	25.98	26.9	14445	26.84	26.89	28.8	15592	28.75	28.80	28.8	14054	28.78	28.83	28.9	14887	28.84	28.89	<b>&lt;0.001</b>	<b>&lt;0.001</b>
<b>Age-specific estimates</b>																														
18 – 19 y.o.	8.3	368	8.28	8.40	9.2	323	9.10	9.23	10.7	371	10.60	10.73	8.7	351	8.60	8.72	9.8	324	9.75	9.88	9.9 <sup>a</sup>	240	9.86	9.99	9.9 <sup>a</sup>	212	9.88	10.01	<b>&lt;0.001</b>	<b>&lt;0.001</b>
20 – 29 y.o.	14.7	2788	14.65	14.72	15.8	2649	15.72	15.79	16.2	2770	16.17	16.24	16.3	2673	16.26	16.33	17.8	2660	17.75	17.82	16.9	2216	16.91	16.98	17.5	2340	17.48	17.55	<b>&lt;0.001</b>	<b>&lt;0.001</b>
30 – 39 y.o.	22.0	4757	21.91	21.99	22.9	4754	22.85	22.93	22.5	4088	22.42	22.50	23.8	3951	23.78	23.86	26.7	4025	26.63	26.71	26.0	4078	25.96	26.04	26.8	4370	26.79	26.87	<b>&lt;0.001</b>	<b>&lt;0.001</b>
40 – 49 y.o.	23.8	5142	23.74	23.81	24.2	5194	24.17	24.25	25.8	4461	25.75	25.82	28.2 <sup>b</sup>	4433	28.14	28.22	28.2 <sup>b</sup>	4165	28.14	28.23	30.2	4603	30.18	30.27	30.9	4683	30.82	30.91	<b>&lt;0.001</b>	<b>&lt;0.001</b>
50 – 59 y.o.	27.8	6239	27.72	27.81	28.6	6738	28.57	28.66	29.3	6548	29.21	29.29	30.3	6655	30.22	30.30	31.2	7102	31.19	31.27	31.5	5984	31.49	31.57	31.4	6157	31.36	31.44	<b>&lt;0.001</b>	<b>&lt;0.001</b>
60 – 69 y.o.	28.0	5004	27.99	28.10	30.3	5936	30.25	30.35	30.2	6224	30.14	30.24	30.9	7136	30.82	30.91	31.8	8133	31.72	31.81	31.2	6480	31.20	31.29	32.3	6996	32.25	32.34	<b>&lt;0.001</b>	<b>&lt;0.001</b>
70 – 79 y.o.	22.9	3134	22.80	22.92	24.8	3452	24.78	24.91	25.4	3404	25.29	25.42	26.7	3735	26.65	26.78	27.2	4562	27.15	27.27	28.1	3573	28.09	28.21	29.4	4173	29.36	29.47	<b>&lt;0.001</b>	<b>&lt;0.001</b>
≥ 80 y.o.	15.5	1125	15.39	15.54	16.7	1221	16.58	16.74	17.0	1282	16.91	17.07	16.2	1353	16.14	16.29	19.5 <sup>c</sup>	1605	19.43	19.59	18.4	1161	18.29	18.46	19.5 <sup>c</sup>	1359	19.43	19.58	<b>&lt;0.001</b>	<b>&lt;0.001</b>
<b>Province-specific estimates</b>																														
Newfoundland and Labrador	33.5	1146	33.36	33.66	32.5	1168	32.32	32.62	36.6	1192	36.45	36.75	35.7	1097	35.54	35.84	38.9	1274	38.76	39.06	41.0	1140	40.86	41.17	39.4	1146	39.21	39.52	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Prince Edward Island	30.1 <sup>d</sup>	514	29.85	30.41	29.9 <sup>d</sup>	591	29.60	30.16	27.7	461	27.38	27.93	32.7 <sup>e</sup>	492	32.40	32.97	32.9 <sup>e</sup>	546	32.60	33.16	30.9	490	30.64	31.19	34.2	563	33.95	34.51	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Nova Scotia	28.0	1312	27.86	28.07	31.1	1400	30.99	31.21	31.5	1292	31.43	31.65	33.0	1323	32.89	33.11	34.6 <sup>f</sup>	1537	34.45	34.67	34.2	1468	34.14	34.36	34.7 <sup>f</sup>	1498	34.58	34.80	<b>&lt;0.001</b>	<b>&lt;0.001</b>
New Brunswick	30.9 <sup>g</sup>	1346	30.81	31.05	31.1 <sup>g</sup>	1476	30.96	31.21	36.2	1449	36.07	36.32	33.8	1451	33.72	33.96	34.6	1461	34.43	34.68	38.7	1095	38.60	38.86	36.7	1162	36.54	36.79	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Quebec	20.1	5336	20.11	20.18	21.3	4668	21.31	21.38	22.1	4587	22.03	22.10	23.1	4807	23.06	23.12	24.9	5340	24.85	24.92	24.8	5350	24.73	24.80	26.0	5862	26.01	26.08	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Ontario	21.9	9032	21.91	21.96	23.6	10265	23.52	23.58	24.1	9873	24.05	24.11	25.1	10272	25.06	25.12	26.1 <sup>h</sup>	10850	26.11	26.17	26.3	8492	26.26	26.31	26.2 <sup>h</sup>	8937	26.15	26.20	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Manitoba	25.4	1802	25.27	25.46	26.9	2019	26.81	27.00	30.1	1854	30.04	30.24	28.0	1966	27.90	28.09	32.5	2144	32.41	32.61	30.8	1588	30.70	30.90	30.0	1614	29.89	30.08	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Saskatchewan	29.0	2051	28.92	29.14	31.1	2113	31.03	31.25	28.7	2050	28.59	28.80	31.7	2092	31.58	31.80	32.9	2235	32.83	33.04	31.5	1400	31.37	31.57	35.4	1556	35.26	35.47	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Alberta	22.9	2622	22.87	22.98	25.3	2901	25.20	25.31	24.7	2848	24.60	24.70	26.1	2923	26.01	26.12	27.2	3177	27.19	27.29	28.1	3494	28.03	28.13	29.2	3765	29.18	29.28	<b>&lt;0.001</b>	<b>&lt;0.001</b>
British Columbia	19.2	2781	19.14	19.23	18.2	2882	18.14	18.23	18.8	2856	18.74	18.83	20.6	3070	20.58	20.67	21.1	3181	21.01	21.09	21.6	3062	21.57	21.65	22.8	3409	22.78	22.87	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Yukon/Northwest Territories/Nunavut	29.3 <sup>i</sup>	615	28.93	29.64	30.0	784	29.63	30.36	29.5 <sup>i</sup>	686	29.10	29.80	31.9	794	31.51	32.21	34.1	831	33.79	34.47	35.9	756	35.60	36.28	36.9	778	36.58	37.24	<b>&lt;0.001</b>	<b>&lt;0.001</b>

Notes: Data are based on adjusted and weighted estimates.

Proportions compared across CCHS cycles using a two-tailed Pearson chi-square test with subsequent cycle-to-cycle pairwise comparisons using a two-tailed Pearson chi-square test with p-value adjustment for multiple testing according to the Bonferroni method. All pairwise comparisons between CCHS cycles demonstrate a statistically significant difference in proportions with  $p < 0.05$ , except for those cycles indicated by paired tags with superscript letters (a, b, c, etc.). A Cochran-Armitage test of trend shows a significantly increasing trend in obesity prevalence at Canada-wide and all provincial/territorial levels ( $p < 0.001$ ).

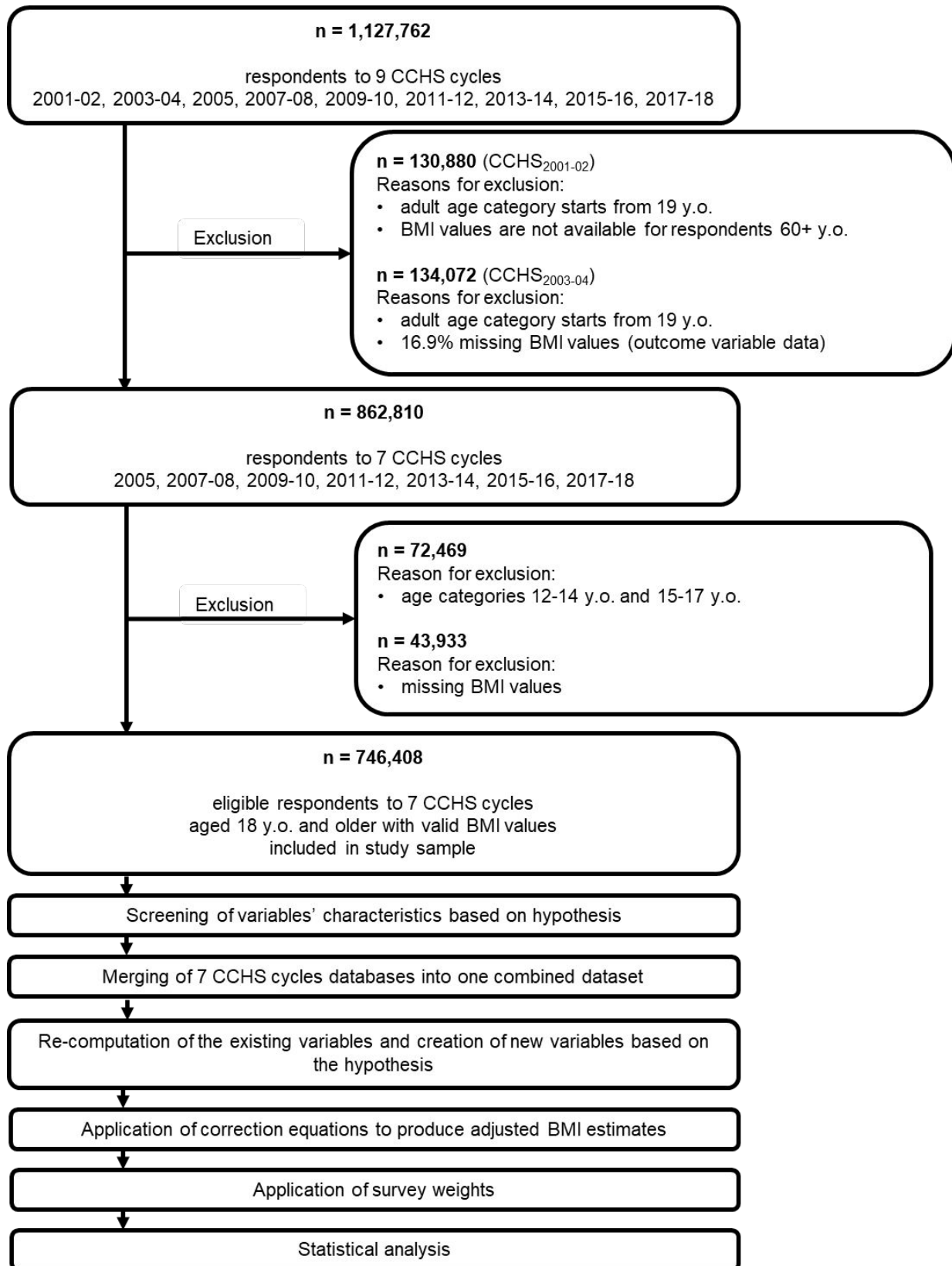


Figure 1. Flow chart outlining the step-wise methodological approach to the study.

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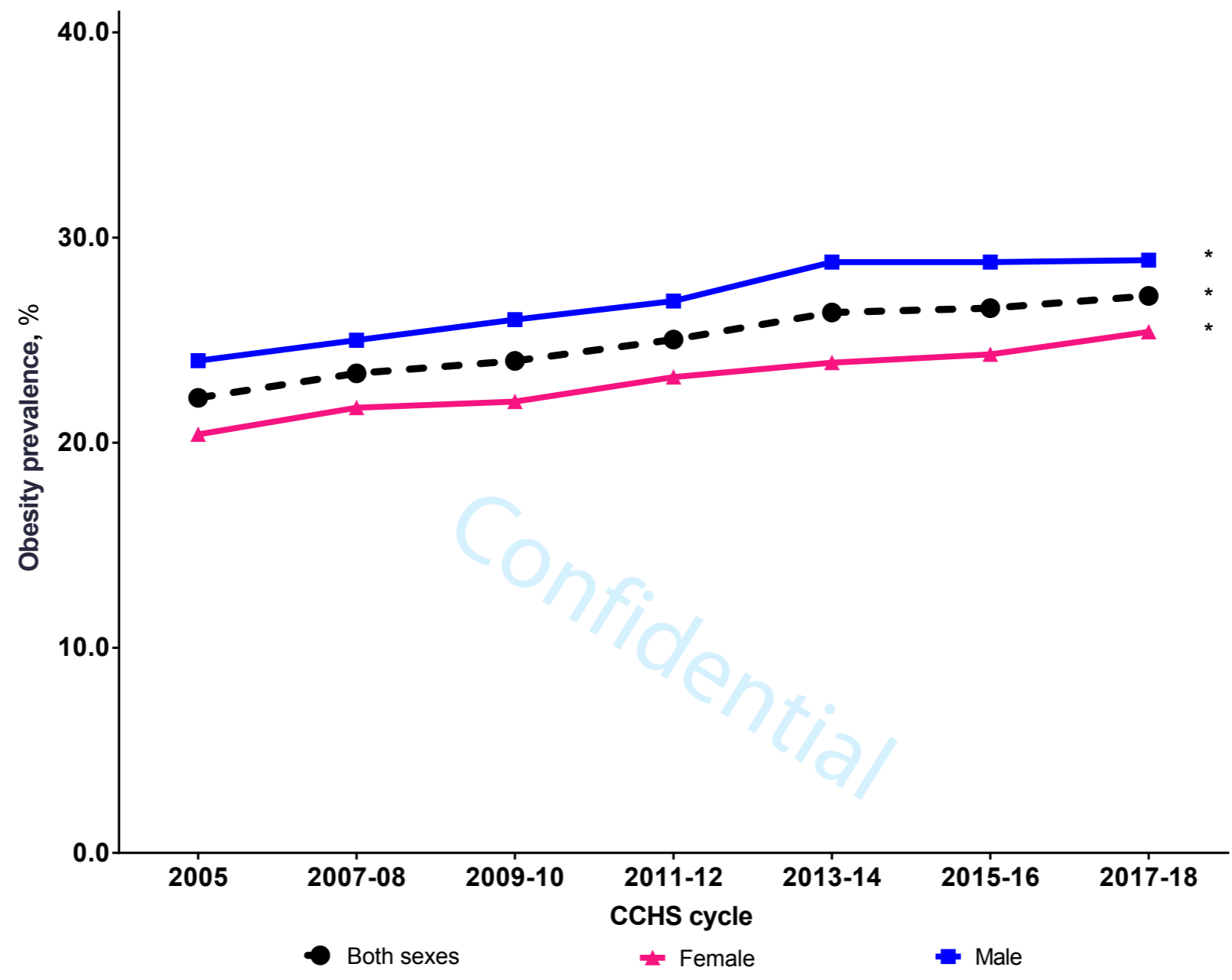


Figure 2. Trends in obesity prevalence among adults, by sex, Canada, from 2005 through 2017-18 (asterisks denote statistically significant increasing trend; p<0.001).

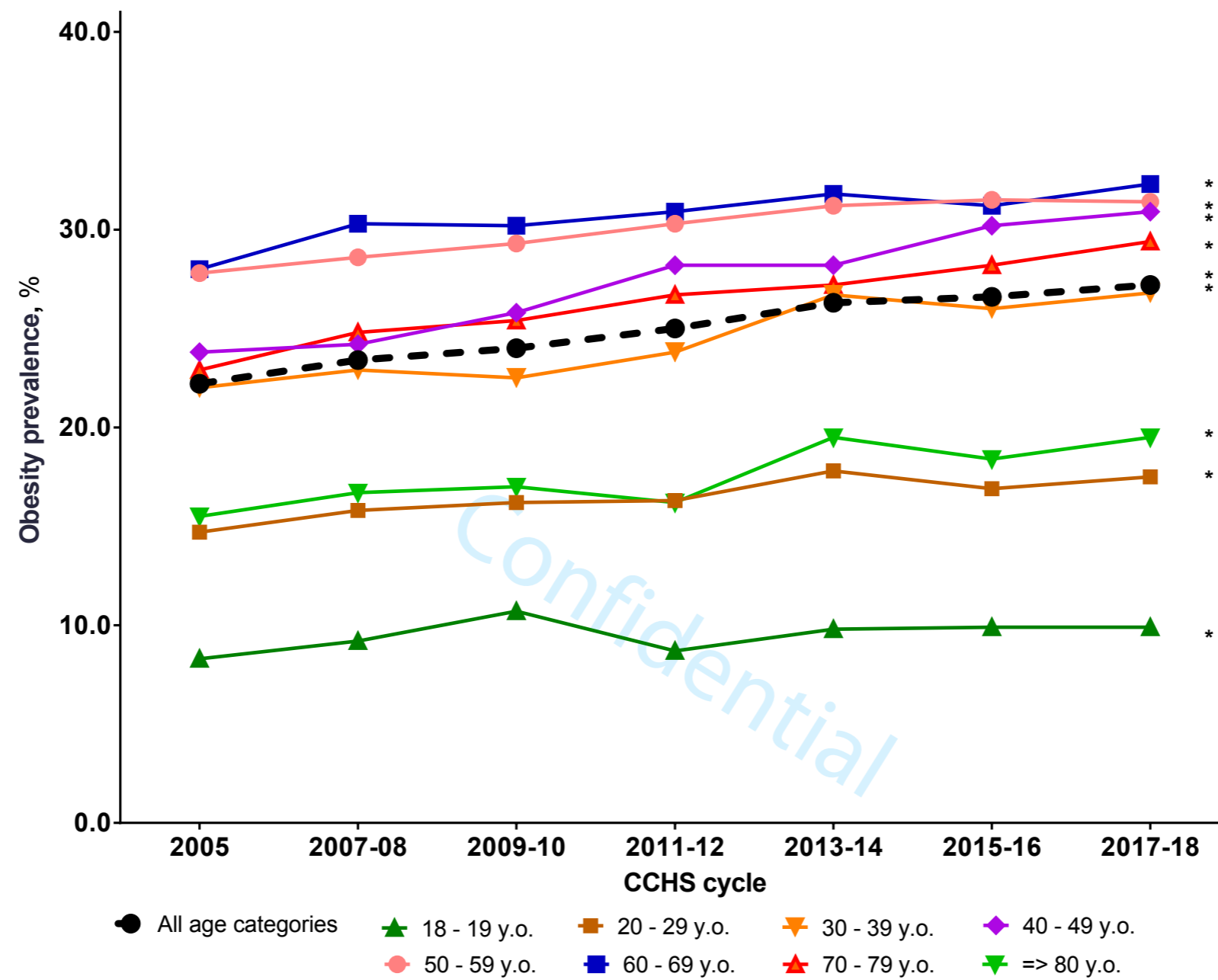


Figure 3. Trends in obesity prevalence among adults, by age categories, Canada, from 2005 through 2017-18 (asterisks denote statistically significant increasing trend; p<0.001).

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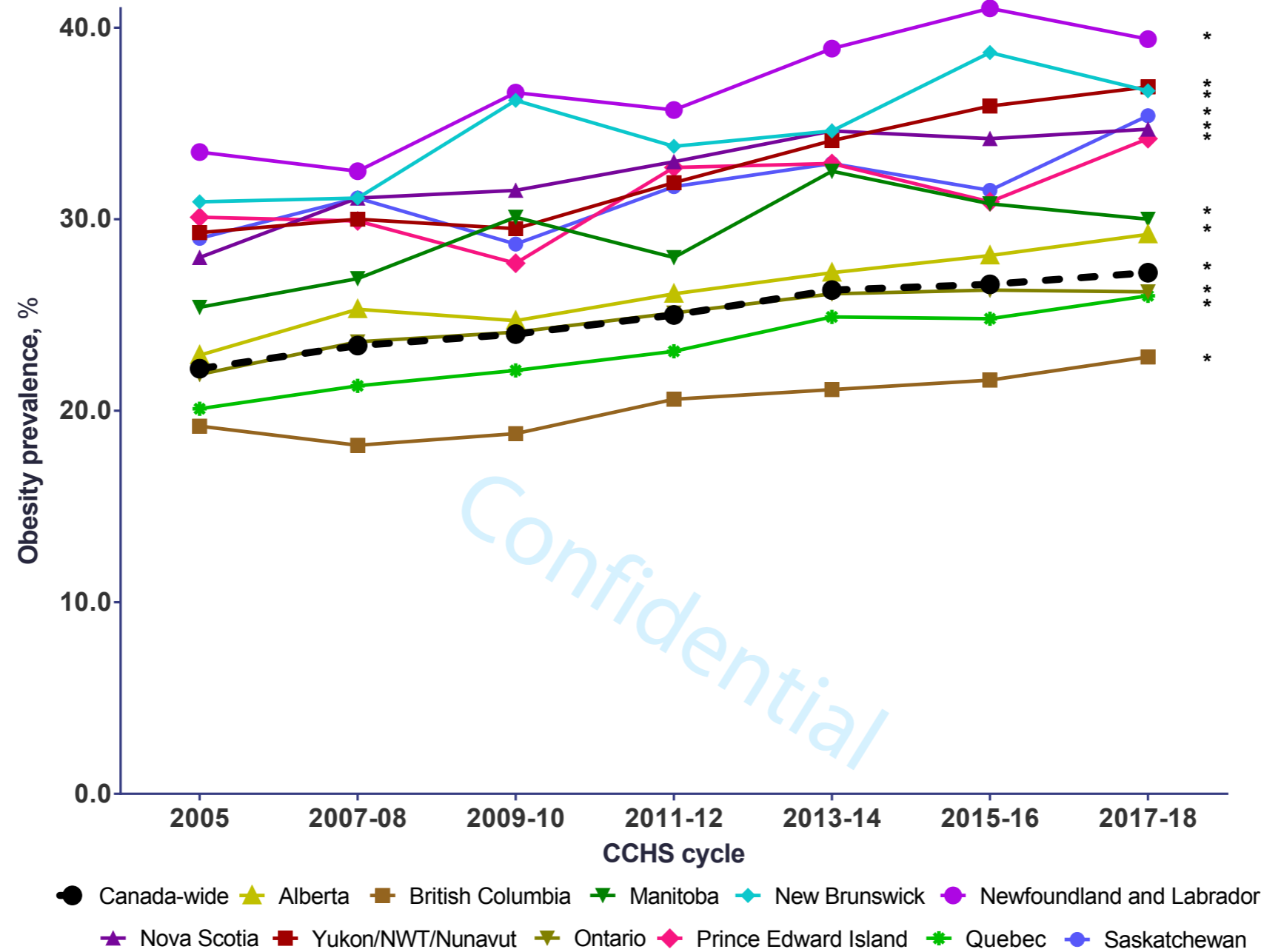
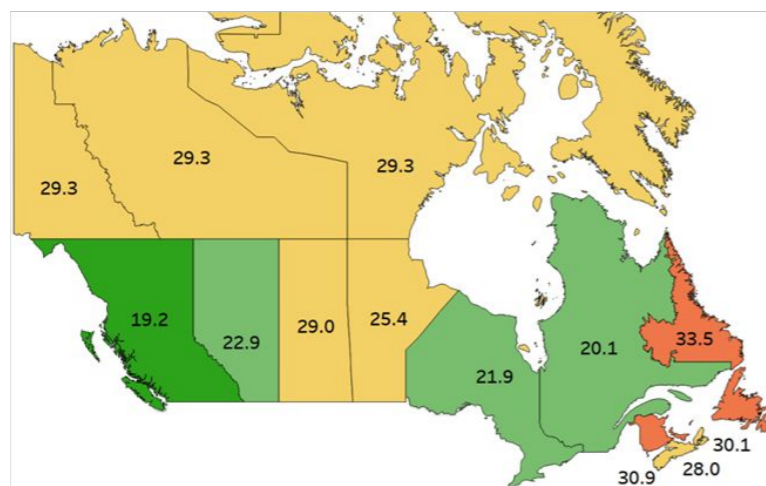


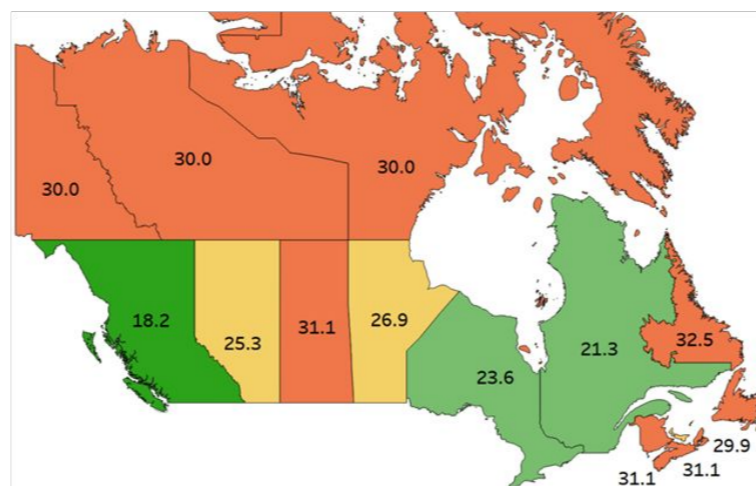
Figure 4. Trends in obesity prevalence among adults, by province/territory, Canada, from 2005 through 2017-18 (asterisks denote statistically significant increasing trend; p<0.001).



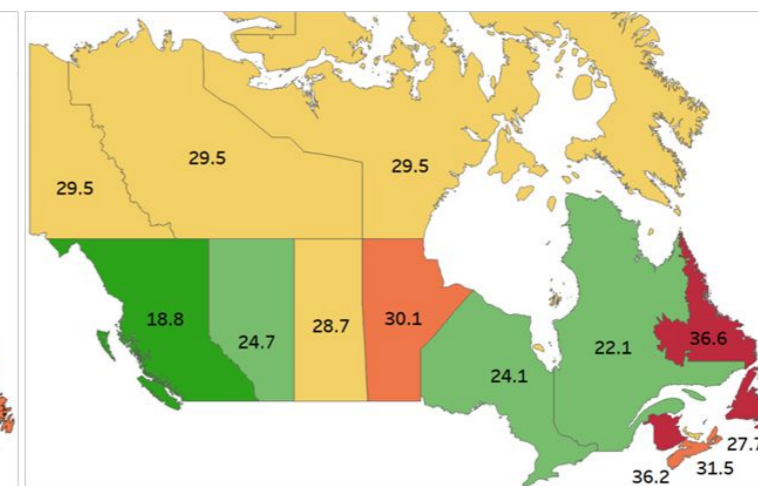
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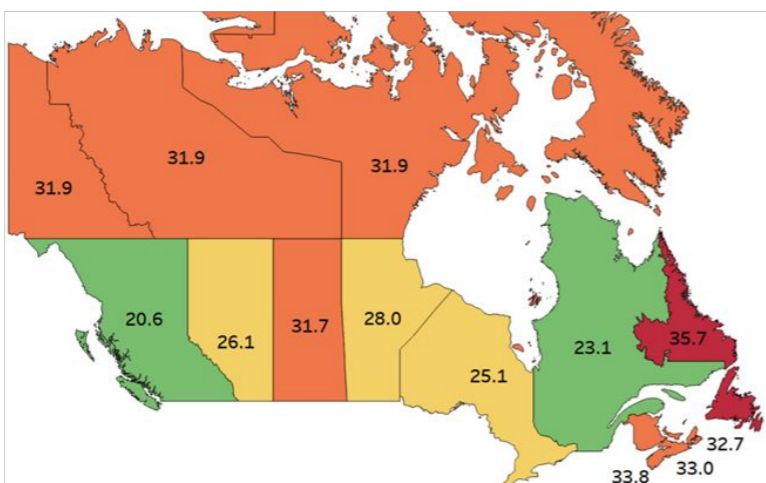
2007-2008



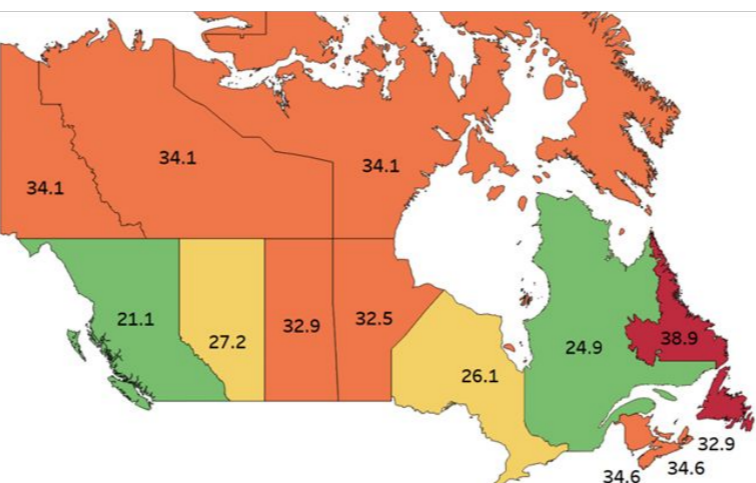
2009-2010



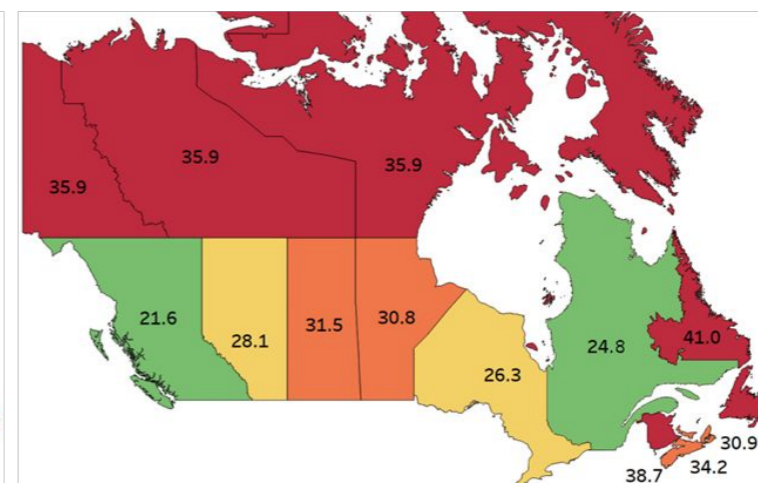
2011-2012



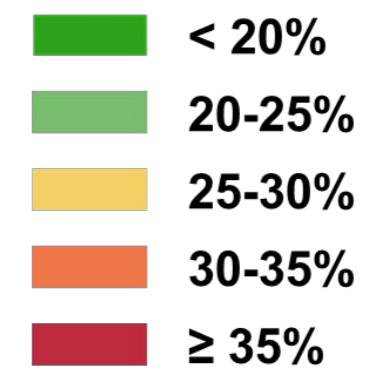
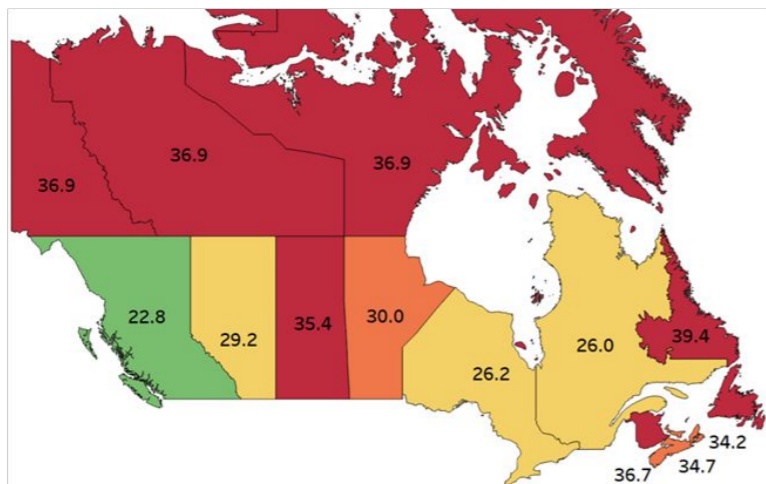
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2015-2016



2017-2018



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Figure 6. Obesity prevalence among Canadian adults, from 2005 through 2017-18.

Confidential

1	Generalisability	<a href="#">#21</a>	Discuss the generalisability (external validity) of the study	N/A
2			results	
3				
4				
5	<b>Other</b>			
6	<b>Information</b>			
7				
8				
9	Funding	<a href="#">#22</a>	Give the source of funding and the role of the funders for the	1
10			present study and, if applicable, for the original study on which	
11			the present article is based	
12				

13  
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15 CC-BY. This checklist was completed on 03 August 2021 using <https://www.goodreports.org/>, a tool  
16 made by the [EQUATOR Network](#) in collaboration with [Penelope.ai](#)  
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1	Generalisability	<a href="#">#21</a>	Discuss the generalisability (external validity) of the study	N/A
2			results	
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5	<b>Other</b>			
6	<b>Information</b>			
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9	Funding	<a href="#">#22</a>	Give the source of funding and the role of the funders for the	1
10			present study and, if applicable, for the original study on which	
11			the present article is based	
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