Globally, there has been a rise in the prevalence of obesity since the early 1980s. In Canada, the percentage of obese adults increased from 14% in 1979 to 23% in 2004. There is evidence that this trend may be due to an increase in sedentary behaviour and calorie intake and a decline in physical activity. Research has shown that intentional weight loss or weight maintenance through lifestyle changes, such as increasing level of physical activity and reducing calorie intake, can significantly reduce the risk of diabetes and cardiovascular disease. Although the benefits of making these lifestyle modifications are widely recognized, sustained behaviour change among individuals is still difficult to achieve. The majority of people may undertake such efforts on their own, through the commercial weight loss/fitness industry and sometimes through the health care system. Low socio-economic status (SES) has been identified as a potential barrier to weight reduction. A review of longitudinal studies describing the relationship between SES and weight change found evidence that individuals of low SES are at higher risk of weight gain. Possible pathways by which low SES could lead to increased weight gain may include: 1) neighbourhood factors such as density of fast-food restaurants and recreational facilities or safety concerns which can impact opportunities for physical activity; and 2) income factors such as equipment or membership costs for physical activities or higher costs of healthy food. However, few studies have reported on the relationship between income and use of weight control strategies. Several cross-sectional population-based studies described factors related to weight loss attempts; however, income was not examined as a determinant. In contrast, qualitative studies of low-income adults with issues of overweight or obesity found that the costs associated with exercising (e.g., cost of exercise equipment and gym memberships) and eating healthy foods were barriers to using them as weight control strategies.

Using a national population survey, this study describes the extent to which Canadian adults have used weight control strategies in the previous year and explores the relationship between use of weight control strategies and income. Given the upward trend in the prevalence of obesity, this study attempts to understand the role of income as a barrier to improving health behaviours related to obesity.

**ABSTRACT**

**Objective:** The goal of this study was to examine use of weight control strategies in Canadian adults and the role of income as a barrier to using these strategies.

**Methods:** Data from the Canadian Community Health Survey cycle 4.1 on health behaviour change was used for this study. Analysis was restricted to adults (18+ years) residing in the 10 provinces of Canada. Respondents were categorized as having used weight control strategies in their lifestyle if they responded that they increased exercise, improved/modified their eating habits, or lost weight in the previous 12 months, as the primary means of health improvement. An adjusted household income ratio divided into deciles was used as a measure of income. Multivariable logistic regression was used to examine the relationship between income and weight control strategies adjusting for known confounders.

**Results:** Of the 103,990 respondents analyzed, 60% were overweight or obese and 45% reported using weight control strategies in the previous 12 months. Age, sex, ethnicity, having a regular doctor, education, and income were all significantly associated with using weight control strategies in the multivariable model. Results that included all two- and three-way interactions between sex, weight category, and income found that lower income was significantly associated with using fewer weight control strategies – more so for obese men and normal weight women.

**Conclusion:** Efforts must be made to create equal access to services and food products that promote weight reduction or control strategies given the rising prevalence of adult obesity in Canada.

**Key words:** Income; weight control; barrier; Canada; adults; survey

La traduction du résumé se trouve à la fin de l’article.
MEASURES

Sample
Data from the Canadian Community Health Survey (CCHS) cycle 4.1 were used for this study. The CCHS is a nationally representative survey of the Canadian population.22 The survey sampled individuals aged 12 and over, living in private dwellings, from all health regions in Canada and excluded those living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions.22

Responses were collected from January 2007 to December 2008.22 The study analysis was restricted to adults (18+ years) who provided a valid response to the outcome measure. The following were excluded from the analysis: pregnant women, as their Body Mass Index (BMI) is transiently influenced; adults who require help moving about inside their home given their inability to be physically active; and data from the three Territories, as Statistics Canada does not report income decile for the Territories (our main independent variable).

Measures
The outcome variable, weight control strategies, was derived from two CCHS questions: 1) “In the past 12 months, did you do anything to improve your health?” and 2) “What is the single most important change you have made?” Those who responded “yes” to the first question and selected either “increased physical activity,” “changed diet/improved eating habits,” or “lost weight” to the second question were categorized as having incorporated weight control strategies. We assumed that those who chose “lost weight” made an adjustment to their lifestyle which could have resulted in weight control or weight loss. Those who answered “no” to the first question or provided an alternative response to the second question were categorized as not using weight control strategies.

The income decile variable created by Statistics Canada was used as a relative measure of household income. Statistics Canada derived this variable by first dividing each respondent’s household income by the low-income cutoff corresponding to the respondent’s household and community size, resulting in an adjusted household income ratio.23 Then, each ratio was divided by the highest ratio for all survey respondents.23 Finally, deciles of the adjusted household income ratio were created for each province and the corresponding deciles were combined for the nation (each decile contains approximately the same percentage of residents for each province).23 Because 12.5% of respondents failed to report their household income, a “missing” category was included in the analysis.

A number of confounders found to be associated with both income and weight control strategies in previous studies14-17 were included as covariates in the analysis. These were age (18-24, 25-34, 35-44, 45-54, 55-64, 65+), sex (white, visible minority), education (≤ secondary school, secondary school graduation, some post-secondary, post-secondary degree/diploma), marital status (married/common-law, widowed/separated/divorced, single), having a regular medical doctor (yes, no), and BMI (<25, 25-<30, 30+; referred to as normal, overweight, and obese, respectively).24 BMI was calculated from self-reported height and weight ([weight (kg)]/[height (m)]²). To account for the known bias associated with self-reported BMI, the estimates were adjusted using the published correction factor which was based on previous CCHS data.25 A chronic condition variable (yes/no) was created to identify individuals with conditions that may affect use of weight control strategies and was included as a covariate in the analysis. Chronic conditions included chronic obstructive pulmonary disorder, diabetes, heart disease, stroke, arthritis, ulcers, and bowel disorders.

Analysis
All analyses were conducted using SAS 9.1 (SAS Institute, Cary, NC). To account for the complex sampling design of the CCHS, probability sampling weights were applied prior to analysis to produce representative estimates. Univariable logistic regression was used to examine bivariable relationships. Multivariable logistic regression was used to examine the relationship between income and weight control strategies controlling for known confounders. A p-value of <0.05 was considered significant. As the study by Bish et al. found differences in weight loss attempts by sex and BMI,18 we included interaction effects of all two- and three-way interactions between sex, weight category and income in our analysis. Interactions that were significant based on Type 3 analysis of effects remained in the final model.
RESULTS

A total of 112,799 adults were eligible for inclusion in the analysis. The study analyzed the 103,990 (92%) who had valid responses for all variables under study. Of the 8,809 respondents excluded due to missing data, 47% also had missing income information. Excluded respondents were significantly less likely to report using weight control strategies and to be educated but more likely to be younger, female, of lower income, of a visible minority, to have a regular doctor, and to be widowed/separated/divorced.

Approximately 60% of the adult respondents were overweight or obese (BMI ≥ 25) and 45% reported using weight control strategies in the previous 12 months (Table 1). Among those who reported using weight control strategies, 64.5% reported they exercised more, 21.5% reported they modified/improved their diet, and 14% reported they lost weight. Use of weight control strategies was less common in the lowest income categories (40-41% in the lowest three categories) compared to the highest income categories (48-49% in the highest three categories).

Table 2. Unadjusted and Adjusted Odds Ratios (OR) and 95% Confidence Intervals of Factors Related to Using Weight Control Strategies in the Previous 12 Months*

<table>
<thead>
<tr>
<th>Weight category</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.22 (1.19-1.26)</td>
<td>1.44 (1.39-1.48)</td>
</tr>
<tr>
<td>Obese</td>
<td>1.24 (1.20-1.28)</td>
<td>1.47 (1.42-1.52)</td>
</tr>
<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>25-34</td>
<td>0.77 (0.73-0.80)</td>
<td>0.69 (0.65-0.72)</td>
</tr>
<tr>
<td>35-44</td>
<td>0.68 (0.65-0.71)</td>
<td>0.59 (0.56-0.62)</td>
</tr>
<tr>
<td>45-54</td>
<td>0.63 (0.61-0.66)</td>
<td>0.53 (0.52-0.58)</td>
</tr>
<tr>
<td>55-64</td>
<td>0.64 (0.61-0.67)</td>
<td>0.55 (0.52-0.59)</td>
</tr>
<tr>
<td>65+</td>
<td>0.37 (0.33-0.43)</td>
<td>0.36 (0.33-0.38)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>1.26 (1.23-1.30)</td>
<td>1.39 (1.36-1.43)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Visible minority</td>
<td>1.16 (1.12-1.19)</td>
<td>1.16 (1.12-1.20)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or common-law</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Widowed/separated/divorced</td>
<td>0.78 (0.75-0.81)</td>
<td>0.93 (0.90-0.97)</td>
</tr>
<tr>
<td>Single, never married</td>
<td>1.29 (1.25-1.33)</td>
<td>1.09 (1.05-1.13)</td>
</tr>
<tr>
<td>Has a regular medical doctor</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>No</td>
<td>0.90 (0.87-0.93)</td>
<td>0.84 (0.81-0.87)</td>
</tr>
<tr>
<td>Chronic condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.85 (0.82-0.87)</td>
<td>1.06 (1.03-1.09)</td>
</tr>
<tr>
<td>No</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than secondary</td>
<td>0.59 (0.57-0.61)</td>
<td>0.70 (0.67-0.73)</td>
</tr>
<tr>
<td>Secondary graduate</td>
<td>0.84 (0.81-0.87)</td>
<td>0.82 (0.79-0.85)</td>
</tr>
<tr>
<td>Some post-secondary</td>
<td>1.03 (0.99-1.08)</td>
<td>0.91 (0.87-0.96)</td>
</tr>
<tr>
<td>Post-secondary graduate</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Household income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decile 1</td>
<td>0.72 (0.68-0.77)</td>
<td>0.75 (0.70-0.79)</td>
</tr>
<tr>
<td>Decile 2</td>
<td>0.73 (0.69-0.78)</td>
<td>0.82 (0.77-0.88)</td>
</tr>
<tr>
<td>Decile 3</td>
<td>0.76 (0.71-0.80)</td>
<td>0.81 (0.77-0.88)</td>
</tr>
<tr>
<td>Decile 4</td>
<td>0.85 (0.80-0.90)</td>
<td>0.89 (0.84-0.95)</td>
</tr>
<tr>
<td>Decile 5</td>
<td>0.87 (0.82-0.92)</td>
<td>0.89 (0.84-0.94)</td>
</tr>
<tr>
<td>Decile 6</td>
<td>0.93 (0.88-0.98)</td>
<td>0.93 (0.88-0.99)</td>
</tr>
<tr>
<td>Decile 7</td>
<td>0.94 (0.89-1.00)</td>
<td>0.94 (0.88-0.99)</td>
</tr>
<tr>
<td>Decile 8</td>
<td>1.03 (0.97-1.09)</td>
<td>1.02 (0.96-1.08)</td>
</tr>
<tr>
<td>Decile 9</td>
<td>1.00 (0.95-1.06)</td>
<td>0.98 (0.93-1.04)</td>
</tr>
<tr>
<td>Decile 10</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Missing</td>
<td>0.78 (0.74-0.83)</td>
<td>0.80 (0.76-0.85)</td>
</tr>
</tbody>
</table>

* Each covariate was modelled separately with weight control strategies for unadjusted results. All covariates were entered into the model for adjusted results. Nagelkerke R-square for the multivariate model was 0.05.

Table 3. Adjusted Odds Ratios and 95% Confidence Intervals of Income Decile Related to Using Weight Control Strategies From a Three-way Interaction Between Income Decile, Sex, and Weight Category*

<table>
<thead>
<tr>
<th>Weight category</th>
<th>Male (Unadjusted OR)</th>
<th>Female (Unadjusted OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal 1</td>
<td>0.98 (0.85-1.14)</td>
<td>0.58 (0.51-0.65)</td>
</tr>
<tr>
<td>Normal 2</td>
<td>0.94 (0.81-1.10)</td>
<td>0.65 (0.57-0.74)</td>
</tr>
<tr>
<td>Normal 3</td>
<td>0.84 (0.72-0.97)</td>
<td>0.72 (0.64-0.81)</td>
</tr>
<tr>
<td>Normal 4</td>
<td>1.02 (0.88-1.18)</td>
<td>0.78 (0.69-0.88)</td>
</tr>
<tr>
<td>Normal 5</td>
<td>1.02 (0.88-1.18)</td>
<td>0.77 (0.68-0.87)</td>
</tr>
<tr>
<td>Normal 6</td>
<td>0.91 (0.78-1.05)</td>
<td>0.92 (0.81-1.04)</td>
</tr>
<tr>
<td>Normal 7</td>
<td>0.91 (0.78-1.05)</td>
<td>0.85 (0.75-0.96)</td>
</tr>
<tr>
<td>Normal 8</td>
<td>1.09 (0.94-1.25)</td>
<td>0.86 (0.76-0.98)</td>
</tr>
<tr>
<td>Normal 9</td>
<td>0.92 (0.79-1.06)</td>
<td>0.92 (0.81-1.04)</td>
</tr>
<tr>
<td>Normal 10</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Missing</td>
<td>0.81 (0.70-0.93)</td>
<td>0.70 (0.63-0.78)</td>
</tr>
</tbody>
</table>

* Adjusted for age group, ethnicity, marital status, having a regular doctor, having a chronic condition, education, and all two- and three-way interactions between sex, weight category, and income decile. Nagelkerke R-square = 0.052.

Results from the bivariable analysis found that all covariates were significantly associated with using weight control strategies (Table 2). Many of the bivariable associations were maintained in the multivariable logistic regression (Table 2), with the exception of having a chronic condition, which went from decreased odds to increased odds of using weight control strategies.

In the multivariate analysis, the relationship between income and weight control strategies revealed a trend toward lower odds of using weight control strategies with low income: decile 1 had 25% lower odds of using weight control strategies, deciles 2 and 3 had about 18% lower odds, and deciles 4 to 7 had 6-11% lower odds.

Testing for interactions found that sex and weight category both moderated the effect of income on use of weight control strategies. A three-way interaction was introduced into the model by including all two- and three-way interaction terms between income, weight category and sex. All interaction terms were significant in Type 3 analysis (p<0.01) except for the interaction between sex and weight category (p=0.19). Results for the model with the two- and three-way interactions are found in Table 3. For males, income decile three in the normal weight category, one and three in the overweight category, and one, three, five, and seven in the obese category had significantly lower odds of incorporating weight control strategies in the previous 12 months compared to those in the highest income level. For females, the lowest five income deciles in the normal weight category had significantly reduced odds of
using weight control strategies while only the lowest two income
deciles among overweight and obese women had significantly
reduced odds compared to the highest income decile.

**DISCUSSION**

This study found that 45% of adults had actively used weight con-
трol strategies in the previous 12 months. This is higher than pre-
viously reported: 33% of Canadian adults reported trying to loss weight between 1986 and 1992.26 As previously reported, women
and adults with higher BMI reported using more weight control
strategies in the previous 12 months than men and adults with
lower BMI.26

The association between income and weight control strategies was
moderated by sex and weight category. More lower income deciles
among obese men and normal weight women had reduced odds of
using weight control strategies than other weight categories of the
same genders. Although previous literature has shown sex and BMI
category differences in using weight control strategies,18 no study has
shown these differences in relation to income. The study by Green
et al. found that the main reason normal weight women attempted
to lose weight was to become more attractive, whereas the main rea-
son overweight and obese women attempted to lose weight was to
improve their health.26 The difference in reasoning may explain why
income for women in the normal weight category is more of a bar-
rrier to using weight control strategies than for overweight and obese
women. Improving health could be a more serious issue for women,
as women would be more inclined to use weight control strategies
despite their income level. The same explanation cannot be given
for men as men have attempted to lose weight to improve their
health regardless of their BMI.26 More research is needed to explore
reasons why income was more of a barrier to use weight control
strategies among certain subpopulations.

Although there are differences in the association of income level
and weight control strategies by sex and weight category, at least
one low income group in each comparison had significantly
reduced odds of using weight control strategies compared to the
highest income group. This study could not determine whether
income acted as a barrier for these individuals or if some other fac-
tor related to income affected their decision to use these strategies;
however, the existence of inequality in using weight control strate-
gies should be a concern for public health professionals. This is par-
ticularly relevant if the aim is to help adults reduce their weight or
maintain their weight, given the recognition that health benefits
are achieved by maintaining an active lifestyle and healthy diet
regardless of weight status.27

In accordance with previous studies, this research found that the
following characteristics were more common among those with higher income: younger adult; visible minority; having a regular doctor; having higher education; being single.10,18,19 Although there are ethnic disparities in weight control strategies by SES,28 we were limited in our ability to identify ethnic differences in this study due to Statistic Canada’s broad visible minority variable. Perhaps most troubling is the finding that adults over the age of 45 were almost two times less likely to use weight control
strategies than those 18-24 years of age, despite being at higher risk
for many chronic diseases. In a post-hoc analysis, we found no sig-
nificant interaction between age, weight category, and chronic con-
ditions, indicating that the association between age and weight

control strategies exists regardless of BMI or presence of chronic
condition. Efforts need to be made to promote healthier lifestyle
choices (e.g., increasing physical activity, improving diet) among
the older population.

The results must be interpreted with caution due to the limita-
tions of this study. First, when respondents were asked about use of
health improvement strategies, they were only allowed to select
one strategy from a list; however, they could have used a weight
control strategy not listed. Also, this study assumed that those who
selected “lost weight in the past 12 months” used at least one
lifestyle modification strategy (e.g., change in physical activity
and/or eating behaviours); however, it is possible that non-
behavioural strategies were employed (e.g., medication, surgery).
The selection of “changed diet/improved eating habits” was also
assumed to have meant healthier dietary habits, but we do not
know the extent to which the diet selected was healthy. Second,
our findings were compared to studies that reported weight loss
attempts although our study focused on weight control, which may
include adults who have used the strategies to maintain their
weight as well as those who would have used them to lose weight.
Given these differences, our comparisons should be cautiously
interpreted. Third, all responses were self-reported and there may
be biases in the way people self-report their weight, income, or
health behaviour. Fourth, the respondents included in the analysis
were found to be different than the ones included due to missing
data, which is important to consider as it can limit the generaliz-
ability of our findings to the Canadian population. Fifth, the
multivariable models used in the study accounted for a small
percentage of the variation of weight control strategies used by the
respondents, suggesting that other unknown factors not examined
may play a larger role in predicting the likelihood of using these
strategies. Sixth, the use of BMI as an anthropometric measure has
been criticized,29 especially in light of new measures such as the
Edmonton Obesity Staging System;30 however, self-reported BMI
remains the most practical and a valid measure of body fatness for
large epidemiological studies.26 Finally, this was a cross-sectional
study; therefore, we were not able to assess direction of causality
nor were we able to assess whether the use of weight control strate-
gies changed weight status.

Despite these limitations, this is the first study in over 15 years
to report national population estimates of use of weight control
strategies among Canadian adults. This study found evidence that
the lowest income groups were associated with reduced odds of
using weight control strategies. This association was present for
more income deciles of normal weight women and obese men than
any other combination of weight category and sex. More research
is needed to understand the decisions behind using weight control
strategies and to determine the types of strategies used to ensure
that these benefit overall health.

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INCOME AND WEIGHT CONTROL STRATEGIES


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Accepted: September 3, 2012

RÉSUMÉ

Objectif : Examiner l’utilisation des stratégies de contrôle du poids chez les adultes canadiens et le rôle du revenu comme obstacle à l’utilisation de ces stratégies.


Résultats : Sur les 103 990 répondants analysés, 60 % étaient en surpoids ou obèses et 45 % ont déclaré avoir utilisé des stratégies de contrôle du poids aux cours des 12 mois précédents. L’âge, le sexe, l’ethnité, le fait d’avoir un médecin régulier, la scolarité et le revenu présentaient tous une corrélation significative avec l’utilisation de stratégies de contrôle du poids dans le modèle multivarié. Selon les résultats incluant toutes les interactions possibles entre le sexe, la catégorie de poids et le revenu, un revenu inférieur présentait une corrélation significative avec l’utilisation d’un moins grand nombre de stratégies de contrôle du poids – davantage encore chez les hommes obèses et les femmes de poids normal.

Conclusion : Était donné la prévalence croissante de l’obésité à l’âge adulte au Canada, il faut s’efforcer d’assurer un accès égal aux services et aux produits alimentaires qui favorisent les stratégies de réduction ou de contrôle du poids.

Mots clés : revenu; contrôle du poids; obstacle; Canada; adulte; enquête