

Prevention and Harm Reduction of Obesity (Clinical Prevention)

Jennifer L. Kuk PhDⁱ, Sonja C. Wicklumⁱⁱ, Laurie K. Twells PhDⁱⁱⁱ

- i) School of Kinesiology and Health Science, York University
ii) Cumming School of Medicine Department of Family Medicine and O'Brien Institute for Public Health, University of Calgary
iii) Faculty of Medicine, Memorial University

Cite this Chapter

Kuk JL, Wicklum SC, Twells LK. Canadian Adult Obesity Clinical Practice Guidelines: Prevention and Harm Reduction of Obesity (Clinical Prevention). Available from: <https://obesitycanada.ca/guidelines/prevention>. Accessed [date].

Update History

Version 1, August 4, 2020. The Canadian Adult Obesity Clinical Practice Guidelines are a living document, with only the latest chapters posted at obesitycanada.ca/guidelines.

KEY MESSAGES FOR HEALTHCARE PROVIDERS

- Obesity is a heterogeneous disease that can develop via slow and steady weight gain over an extended period, or from rapid bursts of weight gain.
- Regular assessments of body weight are needed to catch early weight gain. Use the Edmonton Obesity Staging System to evaluate if the patient has obesity.
- Clinicians should initiate discussion around weight gain early and contemplate interventions that consider its complex causes, providing guidance beyond “eat less and move more.”
- Many medications are associated with weight gain side effects that can contribute to long-term weight gain.
- Excess pregnancy weight gain and post pregnancy weight retention are significantly reduced with behavioural interventions. Clinicians should counsel women attending prenatal care not to exceed pregnancy weight gain guidelines, and also give pregnant women the necessary counselling, as well as dietary, physical activity and psychological interventions within prenatal visits.
- Health benefits of smoking cessation outweigh the cardiovascular consequences associated with smoking cessation related weight gain.
- Short-term behavioural interventions (generally six months or less) aimed at preventing weight gain in young adulthood, menopause, smoking cessation and breast cancer treatment have not yet been shown to be effective.
- Longer interventions will likely be needed to properly examine strategies for preventing weight gain for many of these high-risk groups and in the general population.

KEY MESSAGES FOR PEOPLE LIVING WITH OBESITY

- Preventing or delaying obesity is likely easier than long-term weight reduction.
- Causes of and risk factors for weight gain are wide ranging, extending beyond personal lifestyle choices such as food intake and exercise, and include factors that you may or may not be able to control.
- Obesity can develop with small gains in weight over a long period of time, or from rapid bursts of weight gain.
- Average weight gain in Canada is 0.5kg – 1.0 kg per year.
- People are prone to greater weight gain during certain life stages, including adolescence, young adulthood and pregnancy.
- Raise your weight gain concerns with your primary care physician, even if you have experienced modest weight gain.
- Regular weighing by healthcare providers can help to identify patterns and factors contributing to weight gain early.

Introduction

In our modern environment, there are numerous factors that put adults at risk for weight gain and the development of obesity. From a public health standpoint, prevention of obesity and related health consequences should be a focus of healthcare systems. Preventing obesity can be targeted at the primary, secondary and tertiary care levels, and aimed anywhere from the individual to the population level. These factors are wide ranging and our understanding of them is growing at a rapid pace. Most research interventions and public health initiatives have focused on nutrition and physical activity. However, there are other modifiable factors, such as sleep, stress, use of medications that cause weight gain, gut dysbiosis secondary to antibiotic use,¹ other chronic conditions or smoking that may also influence weight regulation. Other factors that influence weight gain but are much less modifiable include age, genetics, epigenetics, income, physical environment, sociopolitical environment and adverse childhood events, including abuse and neglect.² These factors are not modifiable or less subject to individual control, but may also be potentially important influencers of weight management effectiveness. This chapter discusses the evidence supporting obesity prevention interventions at the primary, secondary and tertiary levels.

Primary prevention

The aim of primary prevention is to minimize weight gain and prevent obesity from developing in the first place. It has been suggested that primary prevention is the most cost-effective option for addressing obesity.³ Due to the high prevalence of obesity, it can be argued that population-level interventions aimed at primary prevention may be more appropriate than interventions aimed at individual-level factors. Commonly proposed targets include unhealthy food/beverage taxation,⁴ calories on menus,⁵ healthy food programs and subsidy, limiting food and beverage advertisement, affordable physical activity options, increasing mixed land use and improving the walkability of the built environment,⁶ and addressing social determinants of health that negatively impact an individual's ability to dedicate time or resources to healthy living fundamentals.

Although it is clear that poor nutrition and a lack of adequate physical inactivity are important risk factors for the development of obesity, there may be other factors that play a significant role. This means that clinicians must consider the underlying root cause for weight gain, as opposed to only targeting the symptom of weight gain. For example, stress, shift work or insufficient sleep could be the underlying reason for increased dietary intake; depression and fatigue can lead to decreased physical activity. Further, depending on the situation, attenuating weight gain as opposed to preventing weight gain or achieving weight loss may be a more reasonable goal.

Currently, there are very few randomized control trials that examine primary prevention for obesity. Of those published, most examine short time periods that are associated with high risk for rapid weight gain. Very few published studies demonstrate the effectiveness of interventions at the population level. Most of the studies demonstrate effects on eating or physical activity behaviour, but

it is unclear whether these results translate into clinically relevant differences in obesity.⁷ Most of the evidence that suggests diet and physical activity play a role in preventing unhealthy weight gain and obesity comes from observational trials.⁸⁻¹¹ Observational trials do not provide strong evidence to base recommendations. Nevertheless, the lack of strong evidence supporting recommendations for obesity prevention should not necessarily preclude clinicians from incorporating these recommendations into practice. It is important to also consider that there are several challenges and barriers that are inherent to conducting prevention research in general.

1) Science is designed to see changes, not a lack of changes:

In terms of standard scientific methods, studies are designed to see differences with an intervention, and there are less agreed-upon methods for determining the lack of a change (i.e. preventing obesity). Because of this, studies that examine weight gain prevention interventions use a high-risk control group (that gains large amounts of weight). In order to demonstrate an attenuation of the small 0.5kg – 1 kg/year weight gains seen in the general population, a very large sample size would be needed, making the research less feasible.

2) Obesity develops over a very long time:

A true primary prevention study would take a representative sample that includes low-risk individuals and provide an intervention to see if the rates of disease (i.e. obesity) are lower. However, because the average weight gain in Canadians is 0.5kg – 1.0 kg per year,¹² a 170 cm tall individual with a BMI of 22.5 kg/m² would increase their BMI by one unit every 1.5 to 3 years, and take approximately 10–20 years to develop obesity. This highlights the long-term nature of obesity and how difficult it is to study with our current funding structure (with grants of less than half of that 10–20 year duration), as well as the expense involved in following individuals over long periods of time.

3) Clinicians routinely counsel on prevention efforts for other health conditions despite little evidence:

Given the evidence-based medicine movement, it might be surprising to consider that clinicians and health policies routinely engage in prevention efforts for several health conditions for which there is also little to no evidence. For example, to our knowledge there are no randomized controlled trials that show that smoking prevention efforts in non-smokers result in a lower risk for lung cancer or heart disease. Further, anti-smoking campaigns and programs have shown reductions in smoking, but cannot causally link these campaigns or programs with changes in lung cancer^{13,14} or heart disease.¹⁴ The majority of evidence used to justify these programs are from observational studies showing a positive effect of smoking cessation on these health outcomes.^{13,15} Nevertheless, we promote smoking abstinence campaigns and interventions aimed at smoking cessation for specific health benefits despite the lack of strong evidence from randomized controlled trials. In the same way, dietary, physical activity and other behavioural interventions have not been causally proven to be helpful for preventing weight gain and obesity. There is substantive observational evidence, as well as limited, short-term, randomized control trial studies, suggesting that behavioural interventions for the primary prevention

of obesity may warrant the same considerations that have been given to smoking and lung cancer.

Primary prevention randomized controlled trials that examine risk factors for weight gain are limited. Within the general population, there have been short studies of dietary interventions examining specific foods, such as yogurt,¹⁶ whey protein-supplementation¹⁷ or poly-unsaturated fatty acids¹⁸ (PUFA), but with limited success. Short-term studies report that behavioural changes, such as self-weighing, frequent reminders or self-reflection, may be associated with significantly less weight gain or even weight loss over the holidays.^{19,20} There are also several published reports on workplace interventions that have been successful in improving knowledge and behaviours but are less likely to report improvements in obesity or weight gain,^{21,22} unless they target weight loss in workers with overweight or obesity.^{23,24} Primary prevention studies tend to be short in duration (less than six months) and are predominantly nutrition and physical activity interventions. This is problematic as primary prevention efforts will likely need to be far longer in order to demonstrate weight gains less than the typical 0.5kg – 1.0 kg/year. There are a few, longer-term, randomized control trials, with most showing no differences in weight gain over time, unless a study was able to induce weight loss.^{25–28}

Most prevention research examines weight gain in high-risk populations or during short periods associated with high risk for weight gain, such as pregnancy or postpartum weight retention,^{29–31} smoking cessation,^{32,33} certain cancer treatments,³⁴ patients using medications associated with weight gain,^{35,36} menopause³⁷ and young adults.³⁸ Of these, limiting pregnancy and postnatal weight gain has received the most attention; behavioural intervention has been demonstrated to be effective. The limited pharmacological options for weight gain prevention have mainly been examined in populations who are more likely to have obesity, such as patients with diabetes or those taking anti-psychotic medications.

Pregnancy: Gestational weight gain and postpartum weight retention

Pregnancy is a period of rapid weight gain. Canadian recommendations suggest weight gained through pregnancy should be between 5 to 18 kg³⁹ depending on the woman's pre-pregnancy BMI category. In reality, half of Canadian women exceed gestational weight gain recommendations.⁴⁰ This is of concern, as greater gestational weight gain results in greater post-partum weight retention.⁴¹ Studies demonstrate that many women retain 2 kg – 5 kg per pregnancy.⁴² Thus, pregnancy and the postnatal period may be particularly important periods for targeted primary weight gain prevention.

Behavioural interventions to prevent excessive gestational weight gain have ranged in their intensiveness and delivery methods. Most use medical nutrition therapy and/or exercise interventions, ranging from in person to telephone or other electronic messaging systems.⁴² Some interventions also incorporate behavioural change strategies to supplement the program. To date, it is unclear which aspects of the intervention or in which combination are the most effective.

A Cochrane review of high-quality evidence published in 2015 by Muktabhant et al.⁴³ reported that nutrition and/or exercise randomized controlled trials are associated with a 20% reduction in risk for excessive gestational weight gain. In this review, the effectiveness of the interventions was not clearly demonstrated in women with overweight or obesity, which is concerning given the already higher risk for negative pregnancy outcomes for both the mother and baby in these populations.⁴² The authors hypothesized there may be differences in physiology and/or other barriers that may require a more intensive intervention to prevent excessive gestational weight gain in women already affected by overweight or obesity. In one study by Yeo et al.,³¹ the authors suggest that interventions delivered by prenatal care providers may be more successful than those delivered outside prenatal care, resulting in 3 kg less gestational weight gain. Though behavioural interventions are effective at reducing gestational weight gain, it is less clear whether these interventions are sufficient to improve maternal and fetal complications.⁴⁴ Nevertheless, prenatal behavioural interventions may present a unique opportunity for obesity prevention at a life stage when women are regularly engaged with their healthcare practitioner.⁴²

Smoking cessation

Smoking cessation is associated with substantial cardiovascular benefits but is also associated with substantial weight gain. For example, Tian et al.⁴⁵ report that individuals who quit smoking gained 2.6 kg more than those who continued to smoke over six years. However, it is important to note that a recent meta-analysis suggests the mortality risk associated with the weight gain associated with smoking cessation is far less than the mortality rate⁴⁶ associated with continuing to smoke. Nevertheless, post cessation weight gain is a significant concern,³² and may negatively impact smoking cessation efforts, particularly in individuals of white ethnicity and those with existing weight concerns.^{32,33} Thus, interventions that address post-cessation weight gain may be important for improving smoking cessation success.

Weight gain associated with smoking cessation is largely attributed to increased energy intake and reduced energy expenditure.⁴⁶ Several studies that tested a combination of smoking cessation and traditional calorie-restriction interventions (using meal replacement or low calorie diets) report mixed results on cessation and weight gain.⁴⁷ Further, there is a concern that strict caloric restriction may impede smoking cessation attempts.^{46,48,49} Not all agree on this point as some suggest that combined weight and smoking cessation programs may in fact improve abstinence short term (< 3 months).⁴⁷ Unfortunately, there do not appear to be long term benefits of behavioural interventions for weight gain prevention.⁴⁷ Similarly, it does not appear that exercise alone is associated with improved weight gain prevention.⁵⁰ That said, evidence from observational trials suggests that individuals who quit smoking are better able to manage their weight if they are physically active.^{46,50} A recent study reports that post cessation weight gain in young adults was not related to dietary and physical activity patterns,⁴⁵ suggesting that post smoking weight management may be far more complicated than can be explained by lifestyle habits alone. Nevertheless, physi-

cal activity and improved dietary habits are likely to have beneficial health effects independent of changes in body weight.

A recent Cochrane review⁵¹ suggests that there is short-term evidence to support the effectiveness of pharmacotherapies to attenuate weight gain post cessation, but as with short-term behavioural interventions it is unclear whether these benefits extend past one year, or which, if any, pharmacotherapy is superior.^{51,52} Thus, it appears that pharmacotherapy delays but does not prevent post cessation weight gain.

In summary, individuals who attempt to quit smoking should be aware of the risk of weight gain. Nevertheless, the health benefits of smoking cessation generally exceed the consequences of some weight gain. However, there is insufficient evidence to strongly recommend any single type of intervention to prevent post cessation weight gain. Adoption of healthy lifestyle habits is recommended as an adjunct for smoking cessation programs.

Cancer treatment

Though weight loss is more common with cancer treatment, some patients gain weight, and weight gain is particularly more common with breast, colorectal, prostate and ovarian cancers.^{33,53,54} Weight gain may be related to certain medications, chemotherapy and hormonal changes.⁵⁵ The vast majority of literature has focused on the efficacy of lifestyle interventions for the prevention of weight gain for breast cancer patients, as most women experience weight gain during breast cancer treatment.⁵⁶ In fact, less than 10% of women who gain weight after receiving a breast cancer diagnosis return to their pre-diagnosis weight, even after six years.³⁴

According to a recent review by Thomson and Reeves,³⁴ most studies do not demonstrate significant weight gain prevention, and none demonstrate longer lasting weight effects after the cessation of the intervention. Though the evidence is limited, some studies suggest that outcomes may be better in postmenopausal women, and that initiating interventions while the patient is still undergoing chemotherapy may be key in preventing weight gain.³⁴ That said, the short-term negative outcomes of weight gain are less consistent than those seen with weight loss,^{54,57–59} with increased mortality risk reported only when the weight gains exceed 10%.⁵⁴ Thus, care must be given to ensure that weight management efforts do not mask negative health outcomes that require intervention.

Medication use

Use of several classes of medications, such as antipsychotics, antidepressants, antihyperglycemics and corticosteroids, are associated with weight gain.^{35,36} The amount of weight gain they are associated with varies; some can be a potentially large contributor to obesity. Thus, from a primary prevention standpoint, clinicians may wish to consider the weight-gaining side effects, if possible, when initiating medications. In general, there is insufficient evidence to suggest the routine prescription of adjunct medications for preventing weight

gain, and it is likely inappropriate from a primary prevention perspective. However, for many of these medications, the magnitude of associated weight gain and the potential for cardiometabolic consequences may warrant consideration.

Antipsychotics

Several anti-psychotic medications are well documented to be associated with weight gain and are associated with the highest levels of weight gain.⁶⁰ In the short-term, anti-psychotics are associated with weight gains of approximately 3.2 kg, and long-term with gains of 5.3 kg compared to placebo control.³⁵ Of these, olanzapine and clozapine are associated with the largest amounts of weight gain³⁶ with as much as 10 kg reported.⁶⁰ Antipsychotics are thought to relate with weight gain through changes in appetite and altered metabolism.⁶¹ Thus, initiating medications with less weight gain tendencies, such as haloperidol, lurasidone, ziprasidone, aripiprazole and amisulpiride,^{62,63} may be preferred options, if clinically appropriate. It may also be important to consider if medications are needed for long-term management, and whether acutely switching to a medication with a better weight-gain profile for maintenance therapy may be appropriate.⁶⁴ If the decision is made to switch medications, symptoms should be closely monitored to address side effects, such as rebound insomnia, and to ensure relapse does not occur.

To prevent the weight gain, pharmacological and behavioural interventions have been examined with variable success. Medical nutrition therapy, physical activity, and cognitive behavioural strategies are associated with medium effect sizes for weight loss trials and large effect sizes for weight gain prevention trials.⁶⁵ However, even with intervention, many patients are still likely to gain weight. Weight gain is also associated with untreated mental illness, and not treating is not an option. Consequently, it may be more beneficial to initiate lifestyle behavioural interventions early after initiating antipsychotic use. Of the pharmacological choices, support exists for metformin as an adjunct therapy,⁶⁶ but this is likely to only be applicable to populations with already prevalent obesity. In general, there is no strong evidence to suggest the routine prescription of adjunct medications for preventing antipsychotic associated weight gain or for achieving weight reduction after weight gain.⁶⁵

Antidepressants

Antidepressants are associated with a more moderate amount of weight gain than antipsychotics, with a recent review citing a 2 kg – 5 kg weight gain associated with tricyclic antidepressants, monoamine oxidase inhibitors and selective serotonin reuptake inhibitors.⁶⁰ However, antidepressants may have a higher global weight gain burden as there are more individuals with depression than schizophrenia.³⁶ Upon initiation of an antidepressant, close monitoring of weight changes is needed as early changes in body weight are highly predictive of long-term changes.⁶⁷ Thus, clinicians should consider early intervention in preventing excessive gain if possible. Weight gain with antidepressant use may be associated with increased appetite but could also indicate changes in the un-

derlying mood disorder.⁶⁰ In observational trials, dietary choices are associated with differences in weight gain,⁶⁸ but depression is often an exclusion criterion for weight management trials. It is thus unclear whether medical nutrition therapy or physical activity therapy are effective in preventing weight gain associated with antidepressant use, particularly in populations without obesity. Again, weight gain is associated with untreated illness as well, and so whenever possible, engagement in healthy nutrition and eating behaviours, as well as weight monitoring, are important when initiating and continuing treatment of depression.

Diabetes medications

Most individuals with type 2 diabetes have obesity, and patients are recommended weight loss to improve risk factors. Some diabetes medications are paradoxically associated with improved insulin sensitivity and increased weight.⁶⁰ Thiazolidinediones, rosiglitazones, pioglitazones, sulfonylureas and meglitinides are associated with weight gains of 1 kg – 4 kg and insulin with higher associated weight gains of 5 kg – 6 kg.⁶⁰ The mechanisms responsible for weight gain vary between the medications, but include increases in appetite, increased lipid storage and fluid retention.⁶⁰ Patients who are prescribed sulfonylureas as a first-treatment strategy typically have greater weight gains³⁶ than with other medications. Metformin is the most commonly prescribed first-line treatment option and is associated with modest weight losses of 1.0 kg – 2.9 kg,³⁶ and may help prevent some of the weight gain associated with other type 2 diabetes medications such as insulin therapy.⁶⁹

Menopause

The transition to menopause is associated with greater-than-normal fat gain, but with only normal rates of age-related weight gain.³⁷ Due to the hormone changes in menopause, there are losses in muscle mass that mask the accelerated gains in fat mass. Despite the beneficial effects of hormone replacement on body fat distribution, it should not be recommended as a treatment for abdominal obesity due to increases in cardiovascular risk.³⁷ Menopause is also associated with increases in sedentary time and physical inactivity, which further exacerbate cardiovascular risk.⁷⁰ Several large interventions have examined the impact of behavioural interventions on weight management, though most examined middle-aged women,⁷¹ and not necessarily the menopausal transition women. Simkin-Silverman et al.²⁸ undertook one of the few studies to demonstrate that lifestyle intervention is successful in preventing weight gain over five-years in women transitioning to menopause. Similarly, Kuller et al.⁷² reported success preventing weight gain over 54 months. In short, more research is needed to determine which components are most important in preventing menopausal related increases in adiposity.

Young adults

Early adulthood has been a life-phase associated with increased risk for weight gain, with one study reporting an average weight gain

of 14 kg over 15 years of follow-up in young adulthood.⁷³ Onset of obesity is common in this age group and thus may represent an important life stage to target with weight gain prevention incentives. In particular, young adults attending post-secondary education are reported to have significant weight gain. A meta-analysis suggests the weight gain in the first year of college to be less than 2 kg,⁷⁴ comparable to the average weight gain for the general population. Most of the literature in young adults that examines obesity prevention involves, in fact, weight loss or weight loss maintenance trials⁷⁵ or observational studies. These interventions use nutrition and physical activity approaches, behavioural change strategies, technology-based programs and educational programs. Interventions in this age group tend to be disappointing, with several reporting no effect of intervention^{76–78} on weight gain prevention. Interventions that do demonstrate significant effects are typically weight loss studies,^{38,79} and overall show modest results of less than 2 kg,⁷⁵ with very limited evidence that this is maintained long term.⁷⁵ This is in accordance with other clinical weight loss research that suggests that younger age is associated with worse weight outcomes.⁸⁰ Thus, younger adults may be a particularly high-risk group for weight gain and poor primary prevention intervention success.

Secondary prevention

Secondary prevention aims to reduce the impact of the disease that has already developed. This is accomplished by early detection and treating the disease as soon as possible in order to slow or stop its progression. Ultimately, the aim of secondary prevention is to return the patient to their original health and functional status to prevent long-term problems.

In terms of obesity, this can be thought of as regular screening and preventing further weight gain in individuals with uncomplicated mild obesity (i.e. Edmonton Obesity Staging System stage 0 or 1). Although obesity is strongly associated with morbidity and mortality, there is substantial variation in the health profiles observed between individuals with the same body mass index. Further, at the lower border of obesity, there are individuals who have not yet developed obesity-related comorbidities, such as hypertension, dyslipidemia, orthopedic problems or diabetes. It has been reported that up to 40% of the population may present with an elevated body mass index, yet can be described as “metabolically healthy” (depending on the definition used to define healthy),⁸¹ or 20 – 25% with an Edmonton Obesity Staging System stage 0 or 1.⁸² Unlike tertiary prevention wherein weight loss is clearly associated with health benefits for patients with prevalent obesity-related morbidity, it is unclear what, if any, benefits there may be for patients who present with metabolically healthy obesity⁸³ or Edmonton Obesity Staging System stage 0 or 1.⁸⁴ There is debate in the published literature as to whether people with metabolically healthy obesity have better long-term health outcomes and a lower mortality risk compared to individuals with obesity and obesity-related complications.^{81,85} Individuals with metabolically healthy obesity tend to be more physically active, with less consistent evidence reported for dietary differences.⁸⁶ This may suggest that behavioural strategies may also play an important role in secondary prevention.

Importance of self-weighing

One of the key considerations for primary and secondary prevention is the concept of regular monitoring and early diagnosis. Obesity is surprisingly hard to recognize without objective assessments,⁸⁷ and may be harder to recognize as the average body mass index in the population is now within the overweight range.⁸⁸ Consequently, despite the attention given to obesity, health practitioners and the general population may be less likely to recognize the need or to pursue obesity prevention interventions.⁸⁸ This would suggest that regular assessments of obesity and weight gain need to be addressed early, preferably as a primary prevention method at primary care. However, to our knowledge there are no randomized controlled trials that examine regular self-weighing in a primary or secondary prevention context. In observational trials, such as the Pound of Prevention Trial and STOP Regain trial, individuals who engaged in self-weighing had less weight gain over time.^{89,90} In the context of weight loss or weight loss maintenance, self-weighing is also associated with better weight outcomes.^{91,92} However, in populations with severe obesity, regular weighing may be a source of stress and frustration that needs to be considered on an individual basis with the patient. Thus, the clinician should initiate respectful conversations around weight and weight gain before the development of obesity.

Tertiary prevention

Tertiary prevention aims to soften the impact of an ongoing illness or injury that has lasting effects. This is done by helping people manage long-term, often-complex health problems and injuries (e.g. chronic diseases, permanent impairments) in order to improve as much as possible their ability to function, their quality of life and their life expectancy. For obesity, this would be synonymous with weight loss and long-term obesity management. This is where the majority of research lies and is the topic of the other guideline chapters.

Acknowledgments

We wish to acknowledge our sincerest gratitude to Alison Farrell Masters in Library and Information Services, Memorial University and Alicia Kimberlyn Taylor PhD (c), Faculty of Medicine, Memorial University for their tremendous efforts in assisting with conducting the systematic review, and to Christine Gray University of Calgary Cumming School of Medicine for her amazing administrative assistance in writing this chapter.

Downloaded from: <https://obesitycanada.ca/guidelines/prevention>

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/) (CC BY-NC-ND 4.0)

The summary of the Canadian Adult Obesity Clinical Practice Guideline is published in the *Canadian Medical Association Journal*, and contains information on the full methodology, management of authors' competing interests, a brief overview of all recommendations and other details. More detailed guideline chapters are published on the Obesity Canada website at www.obesitycanada.ca/guidelines.

Correspondence:

guidelines@obesitynetwork.ca

References

1. Vallianou N, Stratigou T, Christodoulatos GS, Dalamaga M. Understanding the role of the gut microbiome and microbial metabolites in obesity and obesity-associated metabolic disorders: Current evidence and perspectives. *Curr Obes Rep*. 2019;8(3):317-332. doi:10.1007/s13679-019-00352-2
2. Williamson DF, Thompson TJ, Anda RF, Dietz WH, Felitti V. Body weight and obesity in adults and self-reported abuse in childhood. *Int J Obes*. 2002;26(8):1075-1082. doi:10.1038/sj.jco.0802038
3. Gill TP. Key issues in the prevention of obesity. *Br Med Bull*. 1997;53(2):359-388. doi:10.1093/oxfordjournals.bmb.a011618
4. Redondo M, Hernández-Aguado I, Lumbreras B. The impact of the tax on sweetened beverages: A systematic review. *Am J Clin Nutr*. 2018;108(3):548-563. doi:10.1093/ajcn/nqy135
5. Sarink D, Peeters A, Freak-Poli R, et al. The impact of menu energy labelling across socioeconomic groups: A systematic review. *Appetite*. 2016;99:59-75. doi:10.1016/j.appet.2015.12.022
6. Kumanyika SK, Obarzanek E, Stettler N, et al. Population-based prevention of obesity: The need for comprehensive promotion of healthful eating, physical activity, and energy balance: A scientific statement from American Heart Association Council on Epidemiology and Prevention, Interdisciplinary Comm. *Circulation*. 2008;118(4):428-464. doi:10.1161/CIRCULATIONAHA.108.189702
7. Walls HL, Peeters A, Proietto J, McNeil JJ. Public health campaigns and obesity - a critique. *BMC Public Health*. 2011;11:136. doi:10.1186/1471-2458-11-136
8. Fung MDT, Canning KL, Mirdamadi P, Ardern CI, Kuk JL. Lifestyle and weight predictors of a healthy overweight profile over a 20-year follow-up. *Obesity*. 2015;23(6):1320-1325. doi:10.1002/oby.21087
9. Fung TT, Pan A, Hou T, et al. Long-term change in diet quality is associated with body weight change in men and women. *J Nutr*. 2015;145(8):1850-1856. doi:10.3945/jn.114.208785
10. Golubic R, Wijndaele K, Sharp SJ, et al. Physical activity, sedentary time and gain in overall and central body fat: 7-year follow-up of the ProActive trial cohort. *Int J Obes*. 2015;39(1):142-148. doi:10.1038/ijo.2014.66
11. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med*. 2011;364(25):2392-2404. doi:10.1056/NEJMoa1014296
12. Orpana HM, Tremblay MS, Finès P. Trends in weight change among Canadian adults. *Heal Reports*. 2007;18(2):9-16.
13. Parsons A, Daley A, Begh R, Aveyard P. Influence of smoking cessation after diagnosis of early stage lung cancer on prognosis: Systematic review of observational studies with meta-analysis. *BMJ*. 2010;340:b5569. doi:10.1136/bmj.b5569

14. Anthonisen NR, Skeans MA, Wise RA, Manfreda J, Kanner RE, Connett JE. The effects of a smoking cessation intervention on 14.5-year mortality: A randomized clinical trial. *Ann Intern Med.* 2005;142(4):233-239. doi:10.7326/0003-4819-143-8-200510180-00019
15. Critchley JA, Capewell S. Mortality risk reduction associated with smoking cessation in patients with coronary heart disease: A systematic review. *JAMA.* 2003;290(1):86-97. doi:10.1001/jama.290.1.86
16. Sayon-Orea C, Martínez-González MA, Ruiz-Canela M, Bes-Rastrollo M. Associations between yogurt consumption and weight gain and risk of obesity and metabolic syndrome: A systematic review. *Adv Nutr.* 2017;8(Suppl):1465-1545. doi:10.3945/an.115.011536
17. Ooi EM, Adams LA, Zhu K, et al. Consumption of a whey protein-enriched diet may prevent hepatic steatosis associated with weight gain in elderly women. *Nutr Metab Cardiovasc Dis.* 2015;25(4):388-395. doi:10.1016/j.numecd.2014.11.005
18. Abdelhamid AS, Martin N, Bridges C, et al. Polyunsaturated fatty acids for the primary and secondary prevention of cardiovascular disease. *Cochrane Database Syst Rev.* 2018;(11):CD012345. doi:10.1002/14651858.CD012345.pub3
19. Boutelle KN, Baker RC, Kirschenbaum DS, Mitchell ME. How can obese weight controllers minimize weight gain during the high risk holiday season? By self-monitoring very consistently. *Health Psychol.* 1999;18(4):364-368. doi:10.1037/0278-6133.18.4.364
20. Mason F, Farley A, Pallan M, Sitch A, Easter C, Daley AJ. Effectiveness of a brief behavioural intervention to prevent weight gain over the Christmas holiday period: Randomised controlled trial. *BMJ.* 2018;363:k4867. doi:10.1136/bmj.k4867
21. LaCaille LJ, Schultz JF, Goei R, et al. Go!: Results from a quasi-experimental obesity prevention trial with hospital employees. *BMC Public Health.* 2016;16:171. doi:10.1186/s12889-016-2828-0
22. Linde JA, Nygaard KE, MacLehose RF, et al. HealthWorks: Results of a multi-component group-randomized worksite environmental intervention trial for weight gain prevention. *Int J Behav Nutr Phys Act.* 2012;9:14. doi:10.1186/1479-5868-9-14
23. Jaime PC, Bandoni DH, Sarno F. Impact of an education intervention using email for the prevention of weight gain among adult workers. *Public Health Nutr.* 2014;17(7):1620-1627. doi:10.1017/S1368980013001936
24. Salinardi TC, Batra P, Roberts SB, et al. Lifestyle intervention reduces body weight and improves cardiometabolic risk factors in worksites. *Am J Clin Nutr.* 2013;97(4):667-676. doi:10.3945/ajcn.112.046995.1
25. Jeffery RW, French SA. Preventing weight gain in adults: Design, methods and one year results from the Pound of Prevention study. *Int J Obes.* 1997;21(6):457-464. doi:10.1038/sj.ijo.0800431
26. Metzgar CJ, Nickols-Richardson SM. Effects of nutrition education on weight gain prevention: A randomized controlled trial. *Nutr J.* 2016;15:31. doi:10.1186/s12937-016-0150-4
27. Razquin C, Martinez JA, Martinez-Gonzalez MA, Mitjavila MT, Estruch R, Marti A. A 3 years follow-up of a Mediterranean diet rich in virgin olive oil is associated with high plasma antioxidant capacity and reduced body weight gain. *Eur J Clin Nutr.* 2009;63(12):1387-1393. doi:10.1038/ejcn.2009.106
28. Simkin-Silverman LR, Wing RR, Boraz MA, Kuller LH. Lifestyle intervention can prevent weight gain during menopause: Results from a 5-year randomized clinical trial. *Ann Behav Med.* 2003;26(3):212-220. doi:10.1207/S15324796ABM2603_06
29. Tanentsapf I, Heitmann BL, Adegboye ARA. Systematic review of clinical trials on dietary interventions to prevent excessive weight gain during pregnancy among normal weight, overweight and obese women. *BMC Pregnancy Childbirth.* 2011;11:81. doi:10.1186/1471-2393-11-81
30. Walker R, Bennett C, Blumfield M, et al. Attenuating pregnancy weight gain—what works and why: A systematic review and meta-analysis. *Nutrients.* 2018;10(7):944. doi:10.3390/nu10070944
31. Yeo S, Walker JS, Caughey MC, Ferraro AM, Asafu-Adjei JK. What characteristics of nutrition and physical activity interventions are key to effectively reducing weight gain in obese or overweight pregnant women? A systematic review and meta-analysis. *Obes Rev.* 2017;18(4):385-399. doi:10.1111/obr.12511
32. Germeroth LJ, Levine MD. Postcessation weight gain concern as a barrier to smoking cessation: Assessment considerations and future directions. *Addict Behav.* 2018;76:250-257. doi:10.1016/j.addbeh.2017.08.022
33. Tian J, Venn A, Otahal P, Gall S. The association between quitting smoking and weight gain: A systemic review and meta-analysis of prospective cohort studies. *Obes Rev.* 2015;16(10):883-901. doi:10.1111/obr.12448
34. Thomson ZO, Reeves MM. Can weight gain be prevented in women receiving treatment for breast cancer? A systematic review of intervention studies. *Obes Rev.* 2017;18(11):1364-1373. doi:10.1111/obr.12591
35. Tek C, Kucukgoncu S, Guloksuz S, Woods SW, Srihari VH, Annamalai A. Antipsychotic-induced weight gain in first-episode psychosis patients: A meta-analysis of differential effects of antipsychotic medications. *Early Interv Psychiatry.* 2016;10(3):193-202. doi:10.1111/eip.12251
36. Wharton S, Raiber L, Serodio KJ, Lee J, Christensen RAG. Medications that cause weight gain and alternatives in Canada: A narrative review. *Diabetes Metab Syndr Obes Targets Ther.* 2018;11:427-438. doi:10.2147/DMSO.S171365
37. Kapoor E, Collazo-Clavell ML, Faubion SS. Weight gain in women at midlife: A concise review of the pathophysiology and strategies for management. *Mayo Clin Proc.* 2017;92(10):1552-1558. doi:10.1016/j.mayocp.2017.08.004
38. Wing RR, Tate DF, Garcia KR, Bahnson J, Lewis CE, Espeland MA. Improvements in cardiovascular risk factors in young adults in a randomized trial of approaches to weight gain prevention. *Obesity.* 2017;25(10):1660-1666. doi:10.1002/oby.21917
39. Health Canada. Prenatal Nutrition Guidelines for Health Professionals: Gestational Weight Gain. 2010. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/pdf/nutrition/prenatal/ewba-mbsa-eng.pdf.
40. Kowal C, Kuk J, Tamim H. Characteristics of weight gain in pregnancy among Canadian women. *Matern Child Health J.* 2012;16(3):668-676. doi:10.1007/s10995-011-0771-3
41. Fraser A, Tilling K, MacDonald-Wallis C, et al. Associations of gestational weight gain with maternal body mass index, waist circumference, and blood pressure measured 16 years after pregnancy: The Avon Longitudinal Study of Parents and Children (ALSPAC). *Am J Clin Nutr.* 2011;93(6):1285-1292. doi:10.1097/OGX.0b013e31823d84c4
42. Goldstein R, Teede H, Thangaratnam S, Boyle J. Excess gestational weight gain in pregnancy and the role of lifestyle intervention. *Semin Reprod Med.* 2016;34(2):e14-e21. doi:10.1055/s-0036-1583531
43. Muktabhant B, Lawrie T, Lumbiganon P, Laopaiboon M. Diet or exercise, or both, for preventing excessive weight gain in pregnancy. *Cochrane Database Syst Rev.* 2015;(6):CD007145. doi:10.1002/14651858.CD007145.pub3
44. Rogozińska E, Marlin N, Jackson L, et al. Effects of antenatal diet and physical activity on maternal and fetal outcomes: Individual patient data meta-analysis and health economic evaluation. *Health Technol Assess (Rockv).* 2017;21(41):1-158. doi:10.3310/hta21410
45. Tian J, Gall SL, Smith KJ, Dwyer T, Venn AJ. Worsening dietary and physical activity behaviors do not readily explain why smokers gain weight after cessation: A cohort study in young adults. *Nicotine Tob Res.* 2017;19(3):357-366. doi:10.1093/ntr/ntw196
46. Bush T, Lovejoy JC, Deprey M, Carpenter KM. The effect of tobacco cessation on weight gain, obesity, and diabetes risk. *Obesity.* 2016;24(9):1834-1841. doi:10.1002/oby.21582
47. Spring B, Howe D, Berendsen M, et al. Behavioral intervention to promote smoking cessation and prevent weight gain: A systematic review and meta-analysis. *Addiction.* 2009;104(9):1472-1486. doi:10.1111/j.1360-0443.2009.02610.x

48. Cheskin LJ, Hess JM, Henningfield J, Gorelick DA. Calorie restriction increases cigarette use in adult smokers. *Psychopharmacology (Berl)*. 2005;179(2):430-436. doi:10.1007/s00213-004-2037-x
49. Hall SM, Tunstall CD, Vila KL, Duffy J. Weight gain prevention and smoking cessation: Cautionary findings. *Am J Public Health*. 1992;82(6):799-803. doi:10.2105/AJPH.82.6.799
50. Klinsophon T, Thaveeratitham P, Sitthipornvorakul E, Janwantanakul P. Effect of exercise type on smoking cessation: A meta-analysis of randomized controlled trials. *BMC Res Notes*. 2017;10(1):442. doi:10.1186/s13104-017-2762-y
51. Farley AC, Hajek P, Lycett D, Aveyard P. Interventions for preventing weight gain after smoking cessation. *Cochrane Database Syst Rev*. 2012;1:CD006219. doi:10.1002/14651858.CD006219.pub3
52. Yang M, Chen H, Johnson ML, et al. Comparative effectiveness of smoking cessation medications to attenuate weight gain following cessation. *Subst Use Misuse*. 2016;51(5):586-597. doi:10.3109/10826084.2015.1126744
53. Mitsuzuka K, Arai Y. Metabolic changes in patients with prostate cancer during androgen deprivation therapy. *Int J Urol*. 2018;25(1):45-53. doi:10.1111/iju.13473
54. Vergidis J, Gresham G, Lim HJ, et al. Impact of weight changes after the diagnosis of stage III colon cancer on survival outcomes. *Clin Colorectal Cancer*. 2016;15(1):16-23. doi:10.1016/j.clcc.2015.07.002
55. Cleveland RJ, Eng SM, Abrahamson PE, et al. Weight gain prior to diagnosis and survival from breast cancer. *Cancer Epidemiol Biomarkers Prev*. 2007;16(9):1803-1811. doi:10.1158/1055-9965.EPI-06-0889
56. Playdon MC, Bracken MB, Sanft TB, Ligibel JA, Harrigan M, Irwin ML. Weight gain after breast cancer diagnosis and all-cause mortality: Systematic review and meta-analysis. *J Natl Cancer Inst*. 2015;107(12):djv275. doi:10.1093/jnci/djv275
57. Cespedes Feliciano EM, Kroenke CH, Bradshaw PT, et al. Postdiagnosis weight change and survival following a diagnosis of early-stage breast cancer. *Cancer Epidemiol Biomarkers Prev*. 2017;26(1):44-50. doi:10.1158/1055-9965.EPI-16-0150
58. Mardas M, Stelmach-Mardas M, Madry R. Body weight changes in patients undergoing chemotherapy for ovarian cancer influence progression-free and overall survival. *Support Care Cancer*. 2017;25(3):795-800. doi:10.1007/s00520-016-3462-1
59. Meyerhardt JA, Kroenke CH, Prado CM, et al. Association of weight change after colorectal cancer diagnosis and outcomes in the kaiser permanente northern California population. *Cancer Epidemiol Biomarkers Prev*. 2017;26(1):30-37. doi:10.1158/1055-9965.EPI-16-0145
60. Medici V, McClave SA, Miller KR. Common medications which lead to unintended alterations in weight gain or organ lipotoxicity. *Curr Gastroenterol Rep*. 2016;18(1):2. doi:10.1007/s11894-015-0479-4
61. Jain S, Bhargava M, Gautam S. Weight gain with olanzapine: Drug, gender or age? *Indian J Psychiatry*. 2006;48(1):39-42. doi:10.4103/0019-5545.31617
62. Leucht S, Cipriani A, Spineli L, et al. Comparative efficacy and tolerability of 15 antipsychotic drugs in schizophrenia: A multiple-treatments meta-analysis. *Lancet*. 2013;382(9896):951-962. doi:10.1016/S0140-6736(13)60733-3
63. Rummel-Kluge C, Komossa K, Schwarz S, et al. Head-to-head comparisons of metabolic side effects of second generation antipsychotics in the treatment of schizophrenia: A systematic review and meta-analysis. *Schizophr Res*. 2010;123(2-3):225-233. doi:10.1016/j.schres.2010.07.012
64. Mukundan A, Faulkner G, Cohn T, Remington G. Antipsychotic switching for people with schizophrenia who have neuroleptic-induced weight or metabolic problems. *Cochrane Database Syst Rev*. 2010;(12):CD006629. doi:10.1002/14651858.CD006629.pub2
65. Dayabandara M, Hanwella R, Ratnatunga S, Seneviratne S, Suraweera C, de Silva VA. Antipsychotic-associated weight gain: Management strategies and impact on treatment adherence. *Neuropsychiatr Dis Treat*. 2017;13:2231-2241. doi:10.2147/NDT.S113099
66. Siskind DJ, Leung J, Russell AW, Wysoczanski D, Kisely S. Metformin for clozapine associated obesity: A systematic review and meta-analysis. *PLoS One*. 2016;11(6):e0156208. doi:10.1371/journal.pone.0156208
67. El Asmar K, Fève B, Colle R, et al. Early weight gain predicts later weight gain in depressed patients treated with antidepressants: Findings from the METADAP cohort. *J Affect Disord*. 2018;241:22-28. doi:10.1016/j.jad.2018.07.059
68. Shi Z, Atlantis E, Taylor AW, et al. SSRI antidepressant use potentiates weight gain in the context of unhealthy lifestyles: Results from a 4-year Australian follow-up study. *BMJ Open*. 2017;7(8):e016224. doi:10.1136/bmjopen-2017-016224
69. Out M, Miedema I, Jager-Wittenaar H, et al. Metformin-associated prevention of weight gain in insulin-treated type 2 diabetic patients cannot be explained by decreased energy intake: A post hoc analysis of a randomized placebo-controlled 4.3-year trial. *Diabetes Obes Metab*. 2018;20(1):219-223. doi:10.1111/dom.13054
70. Pimenta F, Maroco J, Ramos C, Leal I. Predictors of weight variation and weight gain in peri- and post-menopausal women. *J Health Psychol*. 2014;19(8):993-1002. doi:10.1177/1359105313483153
71. Jull J, Stacey D, Beach S, et al. Lifestyle interventions targeting body weight changes during the menopause transition: A systematic review. *J Obes*. 2014;2014:824310. doi:10.1155/2014/824310
72. Kuller LH, Simkin-Silverman LR, Wing RR, Meilahn EN, Ives DG. Women's healthy lifestyle project: A randomized clinical trial: Results at 54 months. *Circulation*. 2001;103(1):32-37. doi:10.1161/01.CIR.103.1.32
73. Gordon-Larsen P, The NS, Adair LS. Longitudinal trends in obesity in the United States from adolescence to the third decade of life. *Obesity*. 2010;18(9):1801-1804. doi:10.1038/oby.2009.451
74. Vella-Zarb RA, Elgar FJ. The "freshman 5": A meta-analysis of weight gain in the freshman year of college. *J Am Coll Heal*. 2009;58(2):161-166. doi:10.1080/07448480903221392
75. Hebden L, Chey T, Allman-Farinelli M. Lifestyle intervention for preventing weight gain in young adults: A systematic review and meta-analysis of RCTs. *Obes Rev*. 2012;13(8):692-710. doi:10.1111/j.1467-789X.2012.00990.x
76. Lytle LA, Laska MN, Linde JA, et al. Weight-gain reduction among 2-year college students: The CHOICES RCT. *Am J Prev Med*. 2017;52(2):183-191. doi:10.1016/j.amepre.2016.10.012
77. West DS, Monroe CM, Turner-McGrievy G, et al. A technology-mediated behavioral weight gain prevention intervention for college students: Controlled, quasi-experimental study. *J Med Internet Res*. 2016;18(6):e133. doi:10.2196/jmir.5474
78. Willmott TJ, Pang B, Rundle-Thiele S, Badejo A. Weight management in young adults: Systematic review of electronic health intervention components and outcomes. *J Med Internet Res*. 2019;21(2):e10265. doi:10.2196/10265
79. Partridge SR, McGeechan K, Bauman A, Phongsavan P, Allman-Farinelli M. Improved eating behaviours mediate weight gain prevention of young adults: Moderation and mediation results of a randomised controlled trial of TXT2BFIT, mHealth program. *Int J Behav Nutr Phys Act*. 2016;13:44. doi:10.1186/s12966-016-0368-8
80. Jiandani D, Wharton S, Rotondi MA, Ardern CI, Kuk JL. Predictors of early attrition and successful weight loss in patients attending an obesity management program. *BMC Obes*. 2016;3:14. doi:10.1186/S40608-016-0098-0
81. Kramer C, Zinman B, Retnakaran R. Are metabolically healthy overweight and obesity benign conditions?: A systematic review and meta-analysis. *Ann Intern Med*. 2013;159(11):758-769. doi:10.7326/0003-4819-159-11-201312030-00008
82. Padwal RS, Pajewski NM, Allison DB, Sharma AM. Using the Edmonton obesity staging system to predict mortality in a population-representative cohort of people with overweight and obesity. *CMAJ*. 2011;183(14):E1059-E1066. doi:10.1503/cmaj.110387

83. Liu RH, Wharton S, Sharma AM, Ardern CI, Kuk JL. Influence of a clinical lifestyle-based weight loss program on the metabolic risk profile of metabolically normal and abnormal obese adults. *Obesity*. 2013;21(8):1533-1539. doi:10.1002/oby.20219
84. Canning K, Brown RE, Wharton S, Sharma AM, Kuk JL. Edmonton obesity staging system prevalence and the association with weight loss in a publicly funded referral-based obesity clinic. *J Obes*. 2015:619734. doi:10.1155/2015/619734
85. Kuk JL, Rotondi M, Sui X, Blair SN, Ardern CI. Individuals with obesity but no other metabolic risk factors are not at significantly elevated all-cause mortality risk in men and women. *Clin Obes*. 2018;8(5):305-312. doi:10.1111/cob.12263
86. Phillips CM. Metabolically healthy obesity across the life course: Epidemiology, determinants, and implications. *Ann N Y Acad Sci*. 2017;1391(1):85-100. doi:10.1111/nyas.13230
87. Harris C V., Bradlyn AS, Coffman J, Gunel E, Cottrell L. BMI-based body size guides for women and men: Development and validation of a novel pictorial method to assess weight-related concepts. *Int J Obes*. 2008;32(2):336-342. doi:10.1038/sj.ijo.0803704
88. Yates EA, MacPherson AK, Kuk JL. Secular trends in the diagnosis and treatment of obesity among US adults in the primary care setting. *Obesity*. 2012;20(9):1909-1914. doi:10.1038/oby.2011.271
89. Jeffery RW, French SA. Preventing weight gain in adults: The Pound of Prevention study. *Am J Public Health*. 1999;89(5):747-751. doi:10.2105/AJPH.89.5.747
90. Wing RR, Tate DF, Gorin AA, Raynor HA, Fava JL, Machan J. STOP regain: Are there negative effects of daily weighing? *J Consult Clin Psychol*. 2007;75(4):652-656. doi:10.1037/0022-006X.75.4.652
91. Madigan CD, Aveyard P, Jolly K, Denley J, Lewis A, Daley AJ. Regular self-weighing to promote weight maintenance after intentional weight loss: A quasi-randomized controlled trial. *J Public Health (Bangkok)*. 2014;36(2):259-267. doi:10.1093/pubmed/ftd061
92. Shieh C, Knisely MR, Clark D, Carpenter JS. Self-weighing in weight management interventions: A systematic review of literature. *Obes Res Clin Pract*. 2016;10(5):493-519. doi:10.1016/j.orcp.2016.01.004