CLINICAL PRACTICE GUIDELINE 12

The Management of High or Low **Body Mass Index** during Pregnancy 2019 Update

Association of Ontario Midwives
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CLINICAL PRACTICE GUIDELINE NO.12

The Management of High or Low Body Mass Index during Pregnancy

2019 Update

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The views expressed in this guideline are strictly those of the Association of Ontario Midwives. No official endorsement by the Ministry of Health and Long-Term Care is intended or should be inferred.

The AOM is committed, through our statement on Gender Inclusivity and Human Rights, to reflect and include trans, genderqueer and intersex communities in all aspects of our work.

This document contains references to sources that use gendered language to refer to populations of pregnant and birthing people. To represent these sources accurately, we may maintain gendered language.

We support research and knowledge translation that engages and reflects the entire childbearing population.

This guideline reflects information consistent with the best evidence available as of the date issued and is subject to change. The information in this guideline is not intended to dictate a course of action, but to inform clinical decision-making. Local standards may cause practices to diverge from the suggestions within this guideline. If practice groups develop protocols that depart from a guideline, it is advisable to document the rationale for the departure.

Midwives recognize that client expectations, preferences and interests are an essential component in clinical decision-making. Clients may choose a course of action that differs from the recommendations in this guideline, within the context of informed choice. When clients choose a course of action that diverges from a clinical practice guideline and/or practice group protocol, this should be well documented in their charts.

Abbreviations

BMI	Body mass index (kg/m^2)
GDM	Gestational diabetes mellitus
GWG	Gestational weight gain
IOM	Institute of Medicine
IUGR	Intrauterine growth restriction
LBW	Low birth weight
LGA	Large for gestational age
NTD	Neural tube defect
SGA	Small for gestational age

This document replaces AOM Clinical Practice Guideline No. 12: The Management of Women with a Low or High Body Mass Index, published in 2010.

Statement of purpose

The goal of this clinical practice guideline (CPG) is to provide evidence-based recommendations that are consistent with the midwifery philosophy of care. Midwives are encouraged to use this CPG as a tool in clinical decision-making.

Objectives

The objective of this CPG is to provide a critical review of the research literature on the management of uncomplicated pregnancy in clients who have a pre-pregnancy body mass index (BMI) less than (<) 18.5 kg/m^2 or greater than or equal (≥) to 30 kg/m^2.

Topics of interest:

- Risk factors
- Prevention of poor outcomes
- Associated complications (antenatal/intrapartum, postpartum, fetal/neonatal)

Outcomes of interest

Critical:

- Neonatal mortality
- Maternal mortality

Important:

- Potential harms associated with assessment or monitoring (pain and injury, separation of neonate and parent, stigmatization)

Methods

In 2009, a search of the MEDLINE database (Medical Literature Analysis and Retrieval System Online) and the Cochrane Library from 1994 to 2009 was conducted using the following keywords: pregnancy, body mass index, BMI, weight gain, birth weight, postpartum weight, maternal health, preterm delivery, obesity, overweight. Vaginal birth after caesarean section (VBAC) was excluded and is addressed in the AOM's

CPG No. 14: Vaginal Birth after Previous Low-Segment Caesarean Section. Additional search terms were used to provide more detail on individual topics as they relate to pre-pregnancy BMI. Older studies were accessed in cases of commonly cited statistics or significant impact on clinical practice.

In 2019, this CPG was partially updated to include more recent literature published from 2010 to 2018. Based on consultation with the AOM's Clinical Practice Guideline Committee and a preliminary review of emerging research, specific sections of the guideline were selected for updating, and new systematic searches were performed to address these updates. Keywords were similar to those used in the original 2009 search. For each search, two screeners examined the search results and selected research that met specific inclusion criteria and fell within the scope of the original guideline. Changes in evidence have been made to the current edition of this guideline to reflect this new research.

Throughout the CPG, minor updates were made to statistics, and to include information from updated versions of previously referenced literature. Some sections were reorganized or combined to enhance clarity and readability.

Recommendations and summary statements in updated CPGs will now be marked with one of the following labels: [new 2019], [2019] or [2010]. These labels will appear at the end of recommendations or summary statements. See the table below (Key to Partial Update Labelling for Recommendations and Summary Statements) for an explanation of these labels.

Table 1 in the Appendix provides a detailed list of the updated recommendations and summary statements (i.e., [new 2019] statements) in this guideline, along with an explanation for these changes.

Key to Partial Update Labelling for Recommendations and Summary Statements

Recommendation or summary statement label	Meaning of label
[new 2019]	New recommendation or summary statement as of 2019 • Indicates that the recommendation or summary statement is new as of 2019. New evidence has prompted a change to or the addition of a recommendation or summary statement. • An explanation of this change is provided in the Appendix.
[2019]	Reaffirmed recommendation or summary statement as of 2019 • Indicates that the recommendation or summary statement is consistent with new evidence as of 2019. New evidence has not prompted a change to the original statement. • Small changes may have been made to the wording of this statement, but they do not affect the meaning.
[2010]	Unchanged recommendation or summary statement from 2010 • Indicates that the recommendation or summary statement has not been updated since 2010. New evidence has not been reviewed. • Small changes may have been made to the wording of this statement, but they do not affect the meaning.

Review

The original 2010 CPG was reviewed using a modified version of the AGREE instrument (1) and the Values-based Approach to CPG Development (2), as well as consensus of the CPG Committee, the Insurance and Risk Management Program and the AOM Board of Directors. The original CPG critically appraised the available evidence based on the Canadian Task Force of Preventive Health Care. See the table below, Key to evidence statements and grading of recommendations, from the Canadian Task Force on Preventive Health Care).

The updated (current) version of this CPG was reviewed by the CPG Subcommittee and the Insurance and Risk Management Program, and approved by the Board of Directors.

Key to Evidence Statements and Grading of Recommendations, from the Canadian Task Force on Preventive Health Care*

Evaluation of evidence criteria		Classification of recommendation criteria	
I	Evidence obtained from at least one properly randomized controlled trial	A	There is good evidence to recommend the clinical preventive action.
II-1	Evidence from well-designed controlled trials without randomization	B	There is fair evidence to recommend the clinical preventive action.
II-2	Evidence from well-designed cohort (prospective or retrospective) or case-control studies, preferably from more than one centre or research group	C	The existing evidence is conflicting and does not allow one to make a recommendation for or against the use of the clinical preventive action; however, other factors may influence decision-making.
II-3	Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940s) could also be included in this category.	D	There is fair evidence to recommend against the clinical preventive action.
III	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees	E	There is good evidence to recommend against the clinical preventive action.
		L	There is insufficient evidence (in quantity or quality) to make a recommendation; however, other factors may influence decision-making.

Source: (3)

*The evidence in this guideline was originally appraised using the Canadian Task Force on Preventive Health Care (CTFPHC) key to evidence statements and grading of recommendations. (3) The CTFPHC has since adopted the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to grading the quality of evidence and strength of recommendations. In light of the partial nature of this CPG update, we have not amended our appraisal protocol at this time.

INTRODUCTION

This CPG reviews the body of research related to the antenatal, intrapartum and postpartum clinical management of clients with a BMI < 18.5 kg/m^2 or ≥ to 30 kg/m^2. Available evidence on this topic is predominantly observational: primarily retrospective or prospective cohorts, chart reviews or large database analyses. Available randomized controlled trials (RCTs) were limited to nutritional or exercise-based interventions. While many of the studies reviewed lacked a high level of rigour and suffered from methodological limitations, they often demonstrated a significant association between high or low BMI and risk of pregnancy-related complications.

Most important, while this CPG deals with discrete categorizations, BMI is a continuous variable. Not all individuals with high or low BMI are at equal risk for developing pregnancy-related complications. Midwives are encouraged to use this guideline in the context of clinical judgment and midwifery values.

Defining Body Mass Index

BMI is a numerical value that relates weight to height. It is calculated as follows:

Metric formula:	Non-metric formula:
BMI = (weight in kilograms) / (height in metres)^2	BMI = (weight in pounds x 703) / (height in inches)^2

While BMI is used as an indicator of adiposity, it is only an estimate and cannot measure adiposity directly. Other methods used to classify underweight and obesity categorizations include waist circumference, waist-to-hip ratio and specific body weights (e.g., > 90 kg for obesity). (4) Since 2009, the Institute of Medicine (IOM) has used the World Health Organization (WHO) categorization for BMI, a popular and widely accepted standard (Table 1), and it has developed recommendations for gestational weight gain (GWG) based on pre-pregnancy BMI (Table 2). Due to insufficient evidence, the IOM was unable to develop more specific recommendations for gestational weight gain (GWG) among those within obesity classes II and III. (5)

BMI is limited by its distinct categorization of underweight, "normal" weight, overweight, and obesity (which is further separated into obesity classes; see Table 1). The sharp boundaries that separate BMI measurement categories from one another imply that one decimal point can change the recommended course of care for a client, and that healthy individuals can only exist within the "normal" BMI parameters. This contributes to harmful, society-wide stigmatization, particularly for individuals with a high-BMI, who are often perceived as not invested in their health. Furthermore, research demonstrates that BMI alone cannot be relied upon to dictate health status. An analysis of data from the National Health and Nutrition Examination Survey in the United States has found that approximately 29% of individuals who are categorized as obese according to BMI are cardiometabolically healthy, while 30% of "normal"-BMI individuals are cardiometabolically unhealthy. (6)

BMI is further limited in its ability to account for and describe body composition or the distribution of body fat. Accurate measurement of fat distribution is an important factor, as excess abdominal fat is associated with increased health risks compared with fat distribution elsewhere. (7) Furthermore, individuals who are naturally very lean or muscular, or those belonging to certain ethnic or racial groups, are particularly vulnerable to being inappropriately classified using the BMI parameters. (8,9) Midwives should apply BMI in practice with the understanding of its negligible consideration of socio-economic and ethnic differences between individuals.

Currently, BMI is the most widely used variable to examine the health impacts associated with very low or very high levels of adiposity. To make recommendations that are consistent with the available evidence base, this CPG refers specifically to BMI and the WHO's BMI categorization. In an effort to reduce the connotation that a body with a "normal" BMI (18.5-24.9 kg/m^2) equals a healthy body, this CPG will instead use the terminology "recommended BMI."

Midwives should keep in mind the limitations of BMI categorization and weight gain recommendations when reading this CPG, and when recording BMI and establishing individualized management plans with their clients.

Table 1: Obesity and Underweight Classes as Defined by the World Health Organization (10)			
Obesity Classes	BMI (kg/m^2)	Underweight Classes	BMI
Obesity Class I	30-34.9	Severe thinness	< 16
Obesity Class II	35-39.9	Moderate thinness	16-16.99
Obesity Class III	≥ 40	Mild thinness	17-18.49

Table 2: Institute of Medicine Recommendations for Total and Rate of Weight Gain during Pregnancy, by Pre-pregnancy BMI (5)			
Pre-pregnancy BMI	BMI (WHO) (kg/m^2)	Total Weight Gain Range (lbs)	Rate of Weight Gain* in Second and Third Trimester (Mean Range in lbs/wk)
Underweight	< 18.5	28-40	1 (1-1.3)
Recommended weight	18.5-24.9	25-35	1 (0.8-1)
Overweight	25.0-29.9	15-25	0.6 (0.5-0.7)
Obese (all classes)	≥ 30.0	11-20	0.5 (0.4-0.6)

* Calculations assume a 1.1-4.4 lb weight gain in the first trimester (Siga-Ritz, 1994, quoted in (5))

RISK FACTORS FOR DEVELOPING HIGH OR LOW BMI

While genetic and biological factors play a role in the potential for having a high or low BMI, there are several other important contributing factors that differ between populations and among individuals. In particular, research demonstrates that the dramatic rise in obesity in North America can be linked to complex interactions between changes to the social, political and environmental structure over the past couple of decades. (11) For example, a limited investment in accessible infrastructure that promotes healthy practices, coupled with a societal view that idealizes particular bodies, has an influence on population health and behaviours. (11) These issues are heightened for marginalized individuals, demonstrating the importance of social determinants in contributing to health inequities.

The development of equitable policy and infrastructure is required to make significant changes in the rising rates of obesity at the population level. To support clients, midwives may become familiar with and build relationships with community programs and agencies that directly address issues of poverty and marginalization.

Disordered Eating

Eating disorders such as anorexia nervosa, bulimia and binge eating disproportionately affect people of childbearing age compared with the general population. These disorders are often associated with high or low BMI, and they increase the risks of morbidity and mortality. (12) A 2002 survey showed that 1.5% of Canadian women aged 15 to 24 years had an eating disorder (13), and that approximately 3% of women will be affected by an eating disorder in their lifetime. (14) A review of the literature focused on, and limited to, identifying and monitoring eating disorders and the most effective treatment interventions from a midwifery perspective is available (see Eating Disorders and Women's Health: An Update (15)). However, an in-depth discussion and critical appraisal of the evidence is beyond the scope of this guideline.

RECOMMENDATION

1. Offer referral to the most appropriate and available mental health services for clients who have or are suspected of having an eating disorder. [III-C] [2010]

PREVENTION OF POOR OUTCOMES

The information presented below is a summary of prevention or intervention strategies that reduce the risks in pregnancy due to an elevated or decreased BMI. Ultimately, midwives should discuss individualized care plans with clients, tailored to their specific needs, while accounting for individual, social and environmental realities that may affect their clients' ability to achieve and maintain their goals.

Optimizing Gestational Weight Gain

A 2017 systematic review and meta-analysis of 23 cohort studies and 1 309 136 participants found that individuals who gain weight within the recommended ranges outlined in Table 2 have better pregnancy outcomes than those who do not. This suggests that complications related to obesity or underweight can be reduced or prevented through the careful management of weight gain during pregnancy. Compared with those who gained weight within the guidelines, regardless of BMI category pre-pregnancy, GWG below the guidelines was associated with an increased risk for small for gestational age (SGA) (OR 1.53 95% CI 1.44-1.64) and preterm birth (OR 1.70 95% CI 1.32-2.20), with the greatest risk among participants who were underweight pre-pregnancy. In contrast, gaining weight above the guidelines, regardless of BMI category pre-pregnancy, increases the risk for large for gestational age (LGA) (> 90th percentile; OR 1.85 95% CI 1.76-1.95), macrosomia (> 4500 g; OR 1.95 95% CI 1.79-2.11) and caesarean delivery (OR 1.30 95% CI 1.25-1.35). (16) Although the IOM recommendations may provide a general reference for GWG, this research is largely based on observational data. There is also insufficient evidence to report on other adverse outcomes, including preeclampsia and gestational diabetes, which are more common in pregnant people with a high BMI. Until more evidence is available, clients should not rely on specific weight gain targets, but rather focus on optimizing GWG by maintaining a healthy diet and physical activity.

Midwives can mitigate and support BMI-related health complications by engaging in thoughtful, informative conversations with clients about developing and maintaining healthy practices. They can also support clients by connecting them with community health services where appropriate. By using a respectful, informed approach, midwives can identify and contribute to clients' efforts to make positive behavioural changes while remaining mindful that the causes of high or low BMI often extend beyond an individual's control. Midwives should reflect on their own beliefs about individuals with a high- or low-BMI, and they should take care not to perpetuate harmful assumptions about clients' health, eating habits, lifestyle choices or physical ability.

RECOMMENDATION

2. Discuss the benefits of optimizing GWG in pregnancy for clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2. [II-2-B] [new 2019]

SUMMARY STATEMENT

For clients with a BMI ≥ 30 kg/m^2, consider discussing the benefits of achieving a normal BMI prior to the next conception. [new 2019]

Charting Weight Gain on Antenatal Records

The IOM recommends documenting preconception BMI as well as subsequent weight gain throughout pregnancy and sharing these results with clients so they are aware of their progress toward their weight gain goals. (5) Midwives who choose to chart weight gain may be able to help their clients address excessive or inadequate GWG during pregnancy. Research from a longitudinal birth cohort study demonstrates that participants who inaccurately estimated their pre-pregnancy body weight were more likely to gain excessive gestational weight, with the greatest likelihood of excessive gain among individuals who were overweight/obese and who underestimated their true pre-pregnancy weight (OR 7.6 95% CI 3.4-17.0). (17)

When discussing weight charting and management, in particular with high-BMI individuals, research shows that careful wording is important to developing a healthy, respectful relationship between client and clinician. Midwives should avoid such negative terms

as "fat," "fatness," "large size," "heaviness" and "obesity" with high-BMI clients, as these may be interpreted as offensive or distressing and could prevent further discussion on this topic. (18) Rather, "weight," "excess weight" and "BMI" are more likely to be interpreted as neutral or desirable. (18)Midwives should encourage open discussion and questioning, and they should respect the wishes of clients who have specific preferences about the language they prefer their provider to use. Clients should also be given the opportunity to discuss any challenges with weight management, and midwives should respond with appropriate assistance.

In some cases, midwives or clients may choose not to routinely measure or document weight gain. Midwives can offer to have an informed choice discussion about the benefits and risks of charting weight gain for clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2.

The risks and benefits of charting GWG for clients in the recommended BMI category are outside the scope of this guideline.

RECOMMENDATION

3. Midwives may consider calculating and documenting pre-pregnancy BMI on the first antenatal record. If pre-pregnancy weight is unknown, midwives may consider documenting BMI at the intake visit. [III-B] [new 2019]

Nutrition and Physical Activity in Pregnancy

CClients may be offered services for counselling related to nutrition and physical activity to help them achieve their GWG goals. These behavioural interventions can improve long-term health, optimize infant birth weight and help reduce childhood obesity. (5) However, there is a lack of good evidence to guide clinical practice on how to support clients to meet their weight gain goals during pregnancy, specifically which interventions are the most effective. (5) Unfortunately, the ideal format and intensity of methods to limit GWG for high-BMI pregnant people has not been established. (5, 19-21)

A 2018 systematic review and meta-analysis on attenuating pregnancy weight gain discovered that dietary interventions have demonstrated effectiveness in reducing excessive weight gain during pregnancy. However, the researchers could not describe the "optimal" pregnancy diet based on their results. (22) This is consistent with research that failed to find significant associations between particular foods and excessive GWG or inadequate weight gain across all participants. (23) Although most clients will likely benefit from the general dietary advice in Canada's Food Guide, midwives may also refer clients to nutritionists for specific, individualized direction. A systematic review on this topic suggests that social support, knowledge about healthy foods, the skills to prepare meals and the ability to eat at home enabled healthy habits during pregnancy. Cravings, nausea and schedule demands have been observed as barriers to healthy eating. (24) Therefore, the appropriate diet for each client should take into account individual preferences and experiences during pregnancy, time and budget constraints, cultural practices, and food knowledge and preparation skills. (22)

According to the 2018 Canadian Guideline for Physical Activity throughout Pregnancy, developed by the Society of Obstetricians and Gynaecologists (SOGC), exercise during pregnancy is associated with improved cardiovascular function and a reduction of the occurrence of excess weight gain. (19,25) The 2018 SOGC guideline recommends that pregnant people should try to do physical activity at least three days a week, and they should incorporate a variety of exercises, including aerobic exercise, resistance training, gentle stretching and pelvic floor training. (26) Low-risk, previously active individuals can continue their exercise routines. (26) Research demonstrates that a sedentary lifestyle during pregnancy may be associated with adverse outcomes, including loss of muscular and cardiovascular fitness, excessive GWG, higher risk of gestational diabetes or hypertensive disorders of pregnancy, varicose veins and deep vein thrombosis, a higher incidence of complaints for conditions such as dyspnea or lower back pain, and poor psychological adjustment to the physical changes of pregnancy. (26)

Despite the important benefits of physical activity during pregnancy, midwives should be aware that vigorous activity (30 minutes/day) is a significant predictor of inadequate weight gain during pregnancy for clients with a low-BMI (OR 0.76, 95% CI 0.60-0.96, p = 0.005) (27).

Most available research on weight management describes interventions designed for the general population, but the best practices identified are transferable to encourage healthy behaviour changes in pregnant people. Research demonstrates that participants achieve greater improvements in health outcomes when the weight management approach is multifaceted. (28) Thus, an individualized plan that incorporates both diet and physical activity while taking into account individual experiences and knowledge, social support, resource constraints, medical contraindications and referrals to appropriate health care providers will more likely result in optimal GWG.

RECOMMENDATIONS

4. All clients should be counselled about the importance of good nutrition and physical activity during pregnancy. Canada's Food Guide is an example of a nutrition guideline that includes dietary advice for individuals who are pregnant or nursing. [II-2-B] [2010]

5. For clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2, midwives should identify and offer referrals to the most appropriate health care providers available in clients' communities to discuss nutrition, healthy eating and other good habits. [II-2-B] [2010]

HIGH BMI

The worldwide prevalence of obesity has risen dramatically in the past few decades. In 2017, self-reported weight and height data from Statistics Canada observed an obesity rate (BMI ≥ 30 kg/m^2) of 26.9% for Canadians aged 18 and over. (3) More specifically, the percentage of people aged 18 to 34 who were considered obese increased from 17.3% in 2015 to 19.7% in 2017. (30) As the prevalence of obesity increases, midwives will care for more individuals with a high BMI. Midwives should possess the knowledge and skills to manage the clinical outcomes associated with a high BMI, and be aware that clients with a high BMI often experience stigmatization and weight bias from medical professionals. Thus, midwives should make every effort to adapt their care to promote a helpful, healing environment and support a normal birth experience. Such accommodations should include the use of appropriately sized medical equipment, barrier-free washrooms in midwifery clinics, and any necessary consultation or collaboration with other medical and health care professionals. (31)

ANTENATAL AND INTRAPARTUM COMPLICATIONS: HIGH BMI

High BMI is associated with possible complications throughout pregnancy, as described in Tables 4a, 4b, 4c, 5a, 5b, and 5c. The values listed are an accumulation of the available research contained in meta-analyses and/or systematic reviews from 2010 to 2018. The reported ORs and RRs are subject to error, as researchers often fail to adjust for the limitations of BMI, GWG, underlying comorbidities and social/environmental characteristics across studies. This raises the likelihood of confounding and potentially overestimating the independent risks of high BMI during pregnancy. Studies with high-BMI populations may also use different sample selection and analysis techniques that may not be generalizable for Ontario. The following research into risk factors should therefore be interpreted with caution.

Table 3: Strength of OR/RR Values

OR/RR	Strength of Risk Factor
≤ 2.99	Mild
3.00-5.99	Moderate
≥ 6.00	Strong

Table 4a: Antenatal/Intrapartum Complications: BMI ≥ 30 kg/m² compared with a BMI of 18.5-24.9 kg/m²	
Complication(s)	OR/OR range
Mild Risk Factor	
Miscarriage	1.26-1.31 (33,34)
Antenatal anxiety	1.41 (34)
Antenatal depression	1.43 (34)
Caesarean section	2.01-2.05 (34,35)
Moderate Risk Factor	
Preeclampsia	3.15 (36)
Gestational diabetes	3.34-3.76 (34)

Table 5a: Antenatal/Intrapartum Complications: BMI ≥ 40 kg/m² compared with a BMI of 18.5-24.9 kg/m²	
Complication(s)	OR/RR range
Moderate Risk Factor	
Induction of labour	3.66 (35,37)
Preeclampsia	3.80 (37)
Gestational diabetes	5.20 (37)

Research consistently demonstrates that the risk for antepartum and intrapartum health complications increases as BMI increases. In particular, numerous systematic reviews and observational studies have demonstrated a step-wise increase in the risks for hypertensive conditions and preeclampsia (5,38–49) and gestational diabetes mellitus (GDM). (34,37,50) National guidelines on obesity and pregnancy have acknowledged these increased risks, and they recommend that clients be well informed and monitored closely, particularly if they have other risk factors. (51)

Preeclampsia and Hypertension

A recent meta-analysis of approximately 1.4 million people found a moderately increased risk of preeclampsia in pregnant individuals with a BMI ≥ 30 kg/m² compared with individuals within the recommended BMI range (OR 3.15, 95% CI 2.96-3.35). (36) A separate meta-analysis found that the risk of preeclampsia for those with a BMI ≥ 40 kg/m² was moderate (OR 3.80, 95% CI 3.07-4.68), even when potentially confounding risk factors were controlled for. (37)

When assessing and monitoring clients' blood pressure, it is critical that midwives utilize the appropriately sized blood pressure cuff. Blood pressure in high-BMI individuals may be overestimated when cuff sizes are too small, leading to over-diagnosis of hypertension. (52)

The use of low-dose acetylsalicylic acid (ASA) (optimal dosage is unknown but may be between 60 and 150 g) (53) during pregnancy has been shown to provide some preventive benefit for multiple adverse pregnancy outcomes, including preeclampsia and hypertension. (54) Some guideline groups have recommended low-dose ASA for clients with a high-BMI, but only for those with at least one other moderate risk factor for preeclampsia. (51,54) Other moderate risk factors include age > 40 years, family history of preeclampsia and current multiple pregnancy. (51) To learn more about the management of preeclampsia with low-dose ASA, and for further discussion on the relationship between hypertensive disorders during pregnancy and high BMI, refer to the AOM's CPG No. 15: Hypertensive Disorders of Pregnancy. (55)

RECOMMENDATION

6. Obtain and document a baseline blood pressure, using the appropriate cuff size for clients with a BMI ≥ 30 kg/m^2. [II-2-B] [2019]

Gestational Diabetes

The link between GDM and high BMI was demonstrated in a recent overview of systematic reviews, in which a moderately increased risk of developing GDM was found in two meta-analyses among those with a BMI ≥ 30 kg/m^2, compared with individuals within the recommended BMI range (see Table 7a). (34) Despite the known association between obesity and GDM, an updated Cochrane review reported insufficient evidence to support the use of GDM screening based on risk factors (e.g., BMI ≥ 30 kg/m^2) over universal screening. (56) This is consistent with the AOM's 2016 literature review on GDM, which concludes that there remains significant uncertainty and disagreement as to whether all clients should be screened for GDM, or only select clients with specific risk factors. (57) Although the AOM does not outline a specific screening approach, it provides an overview of the current evidence and recommendations from several other guideline development groups, all of which identify BMI ≥ 30 kg/m^2 as a risk factor for GDM. (57)

Research suggests that the risks for adverse perinatal outcomes associated with GDM are likely due to hyperglycemia and the pregnant person's coexisting environment, rather than high BMI, and that well-controlled glucose levels of the pregnant person appear to decrease the occurrence of adverse outcomes. (57) Midwives may refer to the AOM's literature review on GDM for more information on this topic.

RECOMMENDATION

7. For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the higher risk of preeclampsia and GDM, along with the risks and benefits of GDM screening. [II-2-A] [new 2019]

Thromboembolism

Although thromboembolism is reported by other clinical guideline development groups as a serious health risk during high-BMI pregnancies, there is limited systematic research on this association. While a 2016 meta-analysis determined that there is a mild risk for postpartum venous thromboembolism among those with a BMI ≥ 30 kg/m^2 (OR 2.5, 95% CI 1.8-3.5) (see Table 4b) and a moderate risk among individuals with a BMI ≥ 40 kg/m^2 (OR 4.6, 95% CI 3.0-7.2) (see Table 5b) (58), a 2014 systematic review identified three studies with varied results on the risk of antepartum venous thromboembolism in the BMI ≥ 30 kg/m^2 population (59). Of these three studies, one found a strong risk (OR 9.7) for antepartum venous thromboembolism among individuals with a BMI ≥ 30 kg/m^2, while the other two studies found no significant risk for those with a BMI ≥ 30 kg/m^2. (59) Despite this variation, clinical practice guidelines on obesity and pregnancy – including those developed by SOGC 2010 and the American College of Obstetricians and Gynecologists (ACOG) 2015 – acknowledge the increased risk of venous thromboembolism throughout and after pregnancy, particularly if other risk factors are present. (51) The Royal College of Obstetricians and Gynecologists (RCOG) reports several risk factors for venous thromboembolism that should be accounted for when considering thromboprophylaxis, including BMI ≥ 30 kg/m^2, planned caesarean section, age > 35 years and medical comorbidities. (60) Moreover, the RCOG recommends offering postnatal thromboprophylaxis to all pregnant people with a BMI ≥ 40 kg/m^2, regardless of their mode of delivery. (61) However, given the paucity of high-quality evidence on when and in what form thromboprophylaxis should be considered with high-BMI clients (62), the necessity of this treatment should be individually assessed, taking into account the full clinical picture. This is consistent with current guidance from the SOGC. (62)

RECOMMENDATION

8. Midwives should individually evaluate each client's need for thromboprophylaxis. They may consider suggesting an antepartum consultation with a physician for clients with a BMI ≥ 40 kg/m^2, or for clients with a BMI ≥ 30 kg/m^2 and other known risk factors for thromboembolism. [III-C] [new 2019]

Fetal Monitoring

Excessive abdominal adiposity may affect midwives' ability to monitor fetal development during pregnancy

through ultrasound and abdominal palpation. (45) A review of 11 019 pregnancies found that the rate of suboptimal visualization of fetal cardiac structures through ultrasound increased 49.8% and craniofacial structures increased 31% in individuals with a BMI ≥ 30 kg/m^2 compared with those having a BMI < 30 kg/m^2. (63) Midwives may also find abdominal palpation and symphysis-fundal measurements more difficult to interpret in clients with high BMI, as growth charts may not be accurate for this group. (64)

Although fetal heart rate (FHR) monitoring with a Pinard stethoscope or a Doppler ultrasound may be challenging with high-BMI clients, there is no evidence to support the necessity of continuous FHR monitoring during labour on the basis of high BMI alone. (65) Research from 2014 reported no detrimental effect on the accuracy or reliability of abdominal fetal electrocardiograms during labour for pregnant participants with high BMI; therefore, midwives may consider this method when fetal heart rate is difficult to detect. (66)

RECOMMENDATIONS

9. For second-trimester ultrasounds indicating suboptimal visualization, discuss limitations of ultrasound with client and consider offering repeat ultrasound if needed. [III-B] [2019]

10. When abdominal palpation proves challenging and/or symphysis-fundal measurements are unreliable, midwives should discuss the risks and benefits of a third-trimester ultrasound and offer as necessary to address any information gaps. [II-2-B] [2019]

Bariatric Surgery and Pregnancy

Bariatric surgery is performed on people who have a very high BMI. Weight loss is usually achieved with a medical device (gastric banding) or gastric bypass. The majority of bariatric surgery patients are people of childbearing age. (124) In 2007, 1313 surgeries were performed in Canada, with 6783 patients on waiting lists. (125) The most popular surgeries are laparoscopic adjustable gastric band (LAGB) and Roux-en-Y gastric bypass (RYGB), which reduce the size of the stomach. Surgeries that bypass all or part of the small intestine result in food restriction and malabsorption and increase the risk of nutritional deficiencies. (126,127) Evidence on pregnancy outcomes after bariatric surgery is growing but limited, and includes case reports, case-control and cohort studies.

For pregnant individuals who have had gastric bypass, folate, iron and B12 malabsorption and deficiencies may occur. (128) Close monitoring may be particularly important with respect to their nutritional status. (127) GDM testing may require alternate methods, as use of standard glucose solutions can cause rapid gastric emptying. Sugar consumption may cause cramping, diarrhea, hypotension, nausea or tachycardia. Midwives may consider measuring fasting serum glucose periodically, or a referral to a physician for a three-day continuous glucose sensor. While these methods do not supersede traditional oral glucose screening, they might be better tolerated by those who have had bariatric surgery. (128) People whose weight has stabilized and who maintain good nutritional balance throughout their pregnancies may experience less morbidity and mortality than they would have with obesity. Small studies have shown that individuals who have had bariatric surgery have lower risks of preeclampsia, LGA infants, GDM, fetal macrosomia and hypertension disorders. (126,129) In a retrospective study of 808 participants who had surgery before and after delivery, the surgery was independently associated with a reduced risk of diabetes, hypertensive disorders and fetal macrosomia. (130)

Individuals who have had bariatric surgery may be at increased risk of abdominal hernias, gallstones, changes in metabolism (including metabolism of medications), organ displacement as the uterus enlarges, and possible increased risk of intrauterine growth restriction (IUGR). (127) Clients should be encouraged to breast- or chest-feed postpartum. It is important to note, however, that there are limited case reports of nutritional deficiency in the infants of parents who have had gastric bypass, even if the parent is asymptomatic. (131) More research is needed to compare pregnancy complications by the type of surgery. (132)

SUMMARY STATEMENT

Midwives may consider offering continuous fetal heart rate monitoring to clients with a high-BMI in whom fetal heart rate is difficult to detect using intermittent auscultation. [new 2019]

Anesthesia

There are reports in the literature of increased difficulties with placing epidural or spinal catheters and with intubation among individuals with high BMI. (39,67,68) As well, the risk of dural puncture may be greater for individuals with high BMI. However, BMI is a poor predictor of distance to the epidural space, and standard epidural needles can generally be used. (68) If pain relief is requested or necessary for clients with high BMI, it would be ideal to discuss potential complications with them prior to labour.

RECOMMENDATION

11. Midwives should consider offering an antepartum anesthesiology consultation for clients who plan to have an epidural, or for those who wish to have a more detailed discussion about potential anesthesia complications related to BMI ≥ 30 kg/m^2. [III-C] [2019]

POSTPARTUM CONSIDERATIONS: HIGH BMI

Table 4b: Postpartum Complications: BMI ≥ 30 kg/m^2 compared with a BMI of 18.5-24.9 kg/m^2

Complication(s)	OR/OR range
Mild Risk Factor	
Postpartum depression	1.30 (34)
Surgical or caesarean wound infection	1.00-2.10 (34)
Postpartum venous thromboembolism	2.5 (58)
Postpartum hemorrhage	1.2* (69)
Mild to Moderate Risk Factor	
Not initiating breast or chest feeding	1.19-3.65 (34)

Table 5b: Postpartum Complications: BMI ≥ 40 kg/m^2 compared with a BMI of 18.5-24.9 kg/m^2

Complication(s)	OR/RR
Mild Risk Factor	
Postpartum hemorrhage	1.43* (69)
Moderate Risk Factor	
Postpartum venous thromboembolism	4.6 (58)
Surgical or caesarean wound infection	5.94 (37)

*OR value was obtained from a meta-analysis published in 2008. No applicable meta-analyses or systematic reviews that examined risk of postpartum hemorrhage were published in 2010-2018.

Weight Retention and Mental Health

Compared with individuals within the recommended BMI range, individuals with obesity are more likely to experience weight retention post-pregnancy. (5,70–71) Research suggests that excessive weight gain during and after pregnancy may be linked to postpartum depression. (34) To better understand this association, qualitative studies speculate that stigma and judgment associated with obesity, criticisms from health care providers and lack of available social supports may all contribute to

the increased risk of poor mental health for postpartum parents with high BMI. (73) However, these findings cannot be used to determine a direction of association, since those with poor mental health may also struggle with weight management. (34)

Caesarean Wound Infection

There appears to be a moderate risk for surgical or caesarean wound infection among postpartum parents with a BMI ≥ 40 kg/m^2, even when other risk factors are controlled for (AdjRR 5.94, 95% CI 2.98-11.77). (37) However, research on the risk for surgical or caesarean wound infection among those with a BMI ≥ 30 kg/m^2 is inconclusive, with some studies reporting a mild risk and others reporting none. (34) Research in this area comes to little consensus on the factors that contribute to surgical site infection, but factors may include length of surgery, use of prophylactic antibiotics, skin closure technique and comorbidities such as diabetes. (74) Moreover, inconclusive results among those with a BMI ≥ 30 kg/m^2 may be related to limitations of the BMI value, which does not provide an exact measure of excess fat or fat distribution. Indeed, not all individuals with a BMI ≥ 30 kg/m^2 have high levels of excess fat around their abdomen, but those with excess abdominal fat may be more likely to experience friction, sweat and bacteria buildup around the surgical site, thus increasing their risk for infection.

Lactation

Those with a BMI ≥ 30 kg/m^2 are less likely to initiate human milk feeding and they have been shown to have a shorter duration of nursing (both exclusive and any), regardless of GWG. (34,75–79) The precise reason for this association is unclear, but it may be due to a decreased prolactin response to suckling (which would in turn reduce milk production), a delay in lactogenesis, or large breasts that may increase the difficulty of latching. (34,75)

Midwives can play a vital role in encouraging chest/breastfeeding by discussing the numerous benefits for both parent and newborn and by providing lactation support. Midwives should also address any concerns of clients who choose not to nurse.

RECOMMENDATION

12. Midwives are well suited to help clients with a BMI ≥ 30 kg/m^2 who may experience difficulties with nursing to establish good positioning, latch and milk supply. When appropriate, midwives should refer clients to a lactation consultant or other specialist for lactation support. [III-B] [2019]

FETAL AND NEONATAL COMPLICATIONS: HIGH BMI

Table 4c: Fetal and Neonatal Complications: BMI ≥ 30 kg/m^2 compared with Recommended BMI 18.5-24.9 kg/m^2

Complication(s)	OR/OR range
Negligible to Mild Risk Factor	
Preterm birth (< 37 weeks)	1.05-1.23 (34,80)
Mild Risk Factor	
Congenital heart defects	1.17 (81)
Orofacial clefts	1.18 (82)
Infant death (≤ 1 year old)	1.42 (83)
Preterm birth (> 32 weeks)	1.59 (34)
Stillbirth	1.63-2.07 (34,80)
Neural tube defects	1.68-1.87 (34,84)
NICU admission	1.91 (80)
Large for gestational age (> 90th percentile)	1.88-2.42 (80,85,86)

Macrosomia (> 4000 g)	2.00-2.92 (80,85,86)
Mild to Moderate Risk Factor	
Macrosomia (> 4500 g)	2.77-3.23 (85,86)
Moderate Risk Factor	
Childhood obesity	3.06 (86)

Table 5c: Fetal and Neonatal Complications: BMI ≥ 40 kg/m² compared with Recommended BMI 18.5-24.9 kg/m²

Complication(s)	OR/RR
Mild Risk Factor	
Congenital birth defects	1.46 (37)
Preterm birth (< 37 weeks)	1.50 (34)
Stillbirth	2.19 (34)
Preterm birth (< 32 weeks)	2.27 (34)
Moderate Risk Factor	
Large for gestational age (> 90th percentile)	3.14 (37)

Large for Gestational Age and Macrosomia

LGA fetuses (> 90th percentile) and fetal macrosomia (> 4000 g or > 4500 g) are more common in pregnancies with individuals who have a BMI ≥ 30 kg/m² and a BMI ≥ 40 kg/m² (see Table 4c and 5c). (40,44,45,87–90) Macrosomia is associated with an increased risk of shoulder dystocia, birth injury and perinatal death, as well as an increased risk of caesarean delivery. (63) It is important to note that after adjusting for fetal macrosomia, obesity during pregnancy is not an independent risk factor for shoulder dystocia. (39,91,92)

SUMMARY STATEMENT

Clients with a BMI ≥ 30 kg/m² would benefit from informed choice discussions about the increased risk for fetal macrosomia and LGA, and the associated complications this may have during labour and birth. [new 2019]

Neural Tube Defects and Folate Intake

Since the introduction of mandatory folic acid fortification of flour in 1997, there has been a dramatic 46% decrease in neural tube defects (NTDs) in Canada. (93) However, evidence indicates that the risk for NTDs remains especially elevated among individuals with high BMI, even since fortification. (94) A 2016 systematic review and meta-analysis of 22 studies found a pooled OR for NTDs of 1.68 (95% CI 1.51-1.87, p < 0.00001) among those with pre-pregnancy BMI ≥ 30 kg/m² compared with those within the recommended BMI range. (84)

The reasons that individuals with high BMI may be at increased risk for NTDs are not entirely clear. Researchers have suggested that lower fruit and vegetable consumption, overall increased energy intake, higher metabolic demands or a high-glycemic index diet may be more prevalent in this population, decreasing folate availability thereby increasing the risk of NTDs. (95) Recent pharmacokinetic research further elucidates the relationship between high BMI and NTDs. Evidence from one 2013 study demonstrated that women of childbearing age with high BMI versus recommended BMI had different pharmacokinetic responses to an equivalent dosage of folic acid administered after a period of fasting. (96) In this study, the maximum serum folate concentration was 34% lower in the high-BMI group compared with recommended BMI individuals, even though the rate of dietary folate absorption between the groups was the same, indicating that excess body fat may influence folate circulation into tissue. (96) This finding is consistent with a 2017 systematic review, which found that the negative association between

Folic Acid and Folate

Folic acid is a stable synthetic form of folate that is routinely added to supplements, drugs and fortified foods. (133) Once ingested, folic acid must undergo several metabolic steps to be converted into a biologically active tetrahydrofolate (THF) form. (133) Supplementation of folic acid during pregnancy is widely considered safe, and doses up to 5.0 mg have not been known to have adverse effects on pregnant people or fetuses. (134) Some researchers have raised concerns about potential adverse effects of excessive folic acid consumption, but these results are largely inconsistent, and further research with high-BMI individuals is required. (135)

Folate may also be increased through diet, in the form of 5-methyltetrahydrofolate (5-MTHF), which naturally occurs in food and is the most abundant derivative of folate found in the blood. (136) Because 5-MTHF is already biologically active, it requires no further metabolism to be absorbed within the body. (133)

Although most individuals can properly convert folic acid into its active form, this process is disrupted for those with a MTHFR (methylenetetrahydrofolate reductase) genetic mutation. (136) A body of research studying participants within the recommended BMI finds that supplementation with 5-MTHF is equally or more effective when compared with folic acid for increasing folate concentration in the blood in individuals with and without the MTHFR mutation. (136–139) Supplemental forms of 5-MTHF may be safely used as an alternative to folic acid for people within the recommended BMI. However, this research has yet to be replicated among individuals with a high BMI, and thus the efficacy of 5-MTHF for this specific population is currently unknown.

serum folate concentration and BMI remained even after adjustment for folate intake. (97)

This evidence suggests that a proportion of the NTD risk associated with pre-pregnancy high-BMI status may be explained by a decreased concentration of serum folate in the blood. (96-98)Since nutrients for the developing embryo are derived from the pregnant person's serum and folate requirements are higher during pregnancy, limited folate availability may affect the development of the fetus. Individuals with high BMI may require a higher dosage of supplemental or dietary folate to achieve a serum folate concentration that provides protection against NTDs. (99)

One case-control study found that individuals within the recommended BMI range (18.5-24.9 kg/m^2) who supplemented daily with 0.4 mg of folic acid in the periconceptional period (three months before conception and three months after conception), demonstrated a significantly reduced risk for NTDs in comparison to recommended BMI individuals who did not supplement with folic acid (aOR 0.21, 95% CI 0.11-0.40). The risk for NTDs was also reduced among high-BMI individuals who were supplemented with folic acid, but this reduction was not as large when compared with that of recommended BMI individuals (aOR 0.65, 95% CI 0.22-0.89). Considering that high-BMI individuals exhibit lower serum folate levels than recommended BMI individuals, and that the metabolism of folate may differ with adiposity, it is possible that high-BMI participants in this sample were not administered adequate levels of folic acid to ensure a protective effect against NTDs. (99)

Research that has adjusted for the consumption of folate based on BMI has found reductions in NTDs comparable to those of recommended BMI individuals. (95,96.99) Evidence from one case-control study in 2013 assessed the impact of higher intake of dietary folate in individuals with high BMI. In the study, overweight (BMI 25.0-29.9 kg/m^2) and obese (BMI ≥ 30 kg/m^2) participants who consumed 0.45-3.12 mg of dietary folate daily during the periconceptional period significantly reduced their risk of NTD-affected pregnancies (aOR 0.28 95% CI 0.10-0.76). (95) This research suggests that the NTD risk in individuals with high BMI may be attenuated to some degree with a folate-rich diet. Foods rich in naturally occurring folate include asparagus, broccoli, spinach, lentils, beans and liver. (100)

Currently, there is no clear consensus in available literature and among clinical guideline groups on the specific recommended dosage of folate or folic acid for

pregnant clients with a BMI ≥ 30 kg/m^2. Consistent with the above literature, the RCOG 2010 and the Royal Australian and New Zealand College of Obstetricians and Gynecologists (RANZCOG) 2013 recommend a high dose folate supplement of 5 mg/day for clients with a BMI ≥ 30 kg/m^2; ideally given before pregnancy and with continuance through the antenatal period. (61,101) Health Canada guidance from 2010 recommends that all pregnant people supplement with 0.4 mg of folic acid regardless of BMI, but after considering the above research it remains unclear if this dosage is high enough to provide a protective effect for individuals with obesity. (99,102) Although a folate/folic acid dosage ranging from 0.4 mg to 5 mg is likely to provide some preventive benefit for high-BMI clients, more research is needed to recommend a specific dosage that provides the most optimal preventive effect against the development of NTDs for high-BMI clients.

RECOMMENDATION

13. For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the benefits of a diet high in nutrient-dense, folate-containing foods before and during pregnancy to reduce the risk of NTDs. For clients who cannot maintain a high-folate diet, midwives may also discuss the risks and benefits of administering a supplement with 0.4 mg to 5 mg of folic acid. [II-2-B] [new 2019]

MIDWIFERY-SPECIFIC CONSIDERATIONS: HIGH BMI

Establishing IV Access

Visualization and palpation of a suitable vein for IV cannulation may be more challenging in clients with a BMI ≥ 30 kg/m^2. This is due to thicker subcutaneous adipose tissue, which can result in smaller, more superficial veins that often have more valves and bifurcations. (103) In the event of an emergency, midwives may find establishing an IV line in the high-BMI client difficult. Therefore, midwives may consider placing an IV during labour, particularly for a planned home birth.

RECOMMENDATION

14. Midwives should ensure that they feel competent to perform venipuncture and gain IV access in clients with a BMI ≥ 30 kg/m^2, and they may consider establishing IV access during labour in clients who choose home birth. [III-C] [2010]

Choice of Birthplace

A 2013 analysis of data from the Birthplace in England national prospective cohort study examined the risk of adverse outcomes among pregnant individuals with high BMI who planned to give birth at home, in a Freestanding Midwifery Unit (FMU) or in an Alongside Midwifery Unit (AMU). (104) The participants selected for this analysis were considered "otherwise healthy," meaning that before the onset of labour they were not known to have any medical or obstetric history risk factors, according to the National Institute for Health and Care Excellence (NICE) intrapartum care guideline, other than BMI > 35 kg/m^2. Risk factors as identified by NICE include various chronic diseases as well as a history of previous pregnancy-related complications, such as caesarean section, uterine rupture and eclampsia (for a detailed list of risk factors, see Tables 2 and 3 in the Appendix). (105) The results of this study determined that when birth occurred at home, those with a BMI of 30-35 kg/m^2 (obese) and those with a BMI ≥ 40 kg/m^2 (very obese) did not significantly differ from participants within the recommended BMI range (18.5-24.9 kg/m^2) in their risks for neonatal unit admission or intrapartum stillbirth/early neonatal death (AdjRR 1.36, 95% CI 0.80-2.29 for obese; AdjRR 1.17, 95% CI 0.49-2.81 for very obese), or in their risks for obstetric interventions and adverse maternal outcomes (AdjRR 1.04, 95% CI 0.89-1.22 for obese; AdjRR 0.95, 95% CI 0.59-1.52 for very obese). As with those who gave birth at home, no significant differences in risk were found between high-BMI and recommended-BMI participants who opted for a birth in an FMU or an AMU. (104)

Similar results were found in a 2018 national prospective cohort study, which examined the risks for adverse intrapartum and neonatal complications among individuals with a BMI of 35.1-40 kg/m^2 in comparison with recommended-BMI individuals (18.5-24.9 kg/m^2) who were admitted to give birth in an AMU. As with the last study, all participant data was adjusted for confounding risk factors as identified by NICE (see

Tables 2 and 3 in the Appendix), and "otherwise healthy" participants were isolated for sensitivity analysis. The results determined that otherwise healthy nulliparous and multiparous participants with a BMI of 35.1-40 kg/m^2 were not at a significantly greater risk of adverse maternal outcomes that would require obstetric care – although the researchers did indicate that their sample size might have been too small to detect a difference between the groups. Participants with a BMI of 35.1-40 kg/m^2 were also not at a significantly greater risk for adverse neonatal outcomes (including Apgar < 7 at five minutes and neonatal unit admission); and there were no significant differences between these groups for other outcomes examined, including transfer to obstetric care, shoulder dystocia, general anesthesia, vaginal birth, perineal trauma and maternal blood transfusion. Furthermore, 88.3% of those with a BMI of 35.1-40 kg/m^2 had an uncomplicated vaginal birth without third- or fourth-degree perineal trauma, instrumental assistance or blood transfusion, which is comparable to the proportion of recommended-BMI participants in this sample with similar birth experiences (82.7%). However, those with a BMI of 35.1-40 kg/m^2 had a slightly greater risk of caesarean section (AdjRR 1.62, 95% CI 1.02-2.57), and the risk for an urgent caesarean section was higher for nulliparous participants specifically (AdjRR 1.80, 95% CI 1.05-3.08). Nulliparous participants with a BMI of 35.1-40 kg/m^2 also had a significantly higher risk for postpartum hemorrhage (AdjRR 3.01, 95% CI 1.24-7.31). These findings highlight the importance of parity in evaluating the risks for pregnancy complications among those with a BMI of 35.1-40 kg/m^2. (106)

Taken together, this evidence suggests that high BMI on its own is not an indication for hospital birth, and that adverse intrapartum and neonatal risks are low for otherwise healthy pregnant people with high BMI, particularly for those who have given birth before. Midwives should support normal birth and choice of birthplace for pregnant individuals with high BMI while taking into account the client's full clinical picture, values and preferences. Informed choice discussions with clients should not only address the potential risks for intrapartum complications, but should also include information on the potential benefits of giving birth at home or in a birth centre, such as greater comfort and reduced risks for medical intervention. (107)

RECOMMENDATION

15. BMI ≥ 30 kg/m^2 alone is not an indicator for hospital birth. Midwives should support choice of birthplace for clients with a BMI ≥ 30 kg/m^2. [II-2-B] [new 2019]

LOW-BMI PREGNANCY

Background

In 2008, Statistics Canada estimated the prevalence of BMI < 18.5 kg/m^2 as 2% for individuals aged 18 years and older. (108) While many studies examine the health impacts of obesity, fewer studies have examined the health consequences of those who are underweight, with the exception of those that examine the health of individuals with eating disorders such as anorexia nervosa and bulimia. In general, depending on the BMI categorization used to define underweight and the contributing factors that lead to being underweight (e.g., disease, malnutrition, genetically lean body type), expert opinion varies on the actual health consequences of low BMI. In Canada, the health of underweight individuals has not been found to differ substantially from the reference group (BMI 18.5-24.9 kg/m^2). (109) This may be particularly true for individuals who are well nourished but maintain a low BMI due to a genetically lean body type. These clients will not likely require specialized care that differs from that received by clients within the recommended BMI range, especially if they have no other risk factors during pregnancy. However, when malnutrition or disordered eating are the cause of low BMI, maternal morbidity and mortality may result from micronutrient deficiency, infections and anemia. (110,111)

Associated Complications

Low BMI is associated with decreased rates of preeclampsia, gestational hypertension, induction of labour, caesarean delivery and fetal macrosomia when compared with other BMI categories. (112,113) Moreover, pregnant individuals with low BMI exhibit similar rates of chest/breastfeeding initiation and exclusive chest/breastfeeding (114), stillbirth (80), preterm birth < 32 weeks (115) and congenital heart defects (81,116) as pregnant people within the recommended BMI (see Table 6). However, individuals with low BMI at the point of conception have been shown to be at an increased risk for the complications listed under Mild Risk Factors in Table 6. Similar to Tables 4 (a, b and

c) and 5 (a, b and c), Table 6 includes the available risk information from current meta-analyses and systematic reviews published in 2010-2018. This research is also subject to the same limitations mentioned previously in the risk factor section for high-BMI pregnancies (Complications of High BMI), and it should be interpreted with caution. In particular with low-BMI, research in this area is also limited by a failure to determine how the factors that have contributed to low-BMI (e.g., nutrition, poverty, genetics) may influence health outcomes.

Table 6: Risk Factors for Low BMI < 18.5 kg/m² compared with Recommended BMI 18.5-24.9 kg/m²

Complication(s)	OR/RR/OR range
Negligible Risk Factors*	
Congenital heart defects	0.99-1.02 (81,116)
Stillbirth	1.11** (80)
Preterm birth < 32 weeks	1.13*** (115)
Mild Risk Factors	
Miscarriage	1.08 (33)
Preterm birth 32-36 weeks	1.25 (115)
Preterm birth < 37 weeks	1.29-1.32 (80,115,117)
Low birth weight (< 2500 g)	1.47-1.64 (86,115)
Intrauterine growth restriction	1.54 (115)
Low birth weight (< 2000 g)	1.67 (80)
Small for gestational age	1.64-1.81 (80,86,117)

*The statistical analysis determined that the risk for these outcomes did not significantly differ from the recommended BMI comparison group; thus risk is considered negligible.
**Non-significant confidence interval: 95% CI (0.96-1.29)
***Non-significant confidence interval: 95% CI (0.92-1.38)

Malnutrition and Other Comorbidities

Nutrition before conception and during pregnancy plays a vital role in the health of a growing fetus. (118) Individuals with low BMI are more likely to suffer from poor nutritional status or malnourishment, which if left unaddressed can have important health consequences for the pregnant parent and the infant. The association between low BMI and low birth weight (LBW), SGA, preterm birth and intrauterine growth restriction (IUGR) are thought to be linked to a lack of nutrients delivered from pregnant parent to developing fetus, thereby stunting fetal growth. (115,118,119) Infants with a birth weight at or below the third percentile (equivalent to two standard deviations below the mean birth weight for their gestational age) are at significant risk for morbidities, including seizures, respiratory distress and hyperbilirubinemia. (87) Long-term outcomes for infants below the third percentile include metabolic disorders in adulthood, insulin resistance and type 2 diabetes, hypertension, obesity and cardiovascular disease. (87,120) In an effort to prevent morbidity and ensure optimal fetal growth in utero, midwives may support low-BMI clients who wish to learn more about their nutritional needs through education and/or by referring clients to a nutritionist if necessary or when requested. Underweight clients may also be closely monitored for appropriate fetal growth throughout pregnancy via ultrasound or serial growth studies as needed.

Aside from malnutrition, the presence of disordered eating and/or over-exercising behaviours, drug use or underlying medical conditions may be common among low-BMI individuals in developed countries. (115) Although the independent impact of low BMI on the risk of health complications is rather mild (as can be seen in Table 6), the presence of other comorbid conditions such as anorexia or prolonged nicotine use severely increases the risks for serious health consequences such as intrauterine growth restriction. (121)

RECOMMENDATION

16. Clients with a BMI < 18.5 kg/m^2 are at higher risk of IUGR, SGA and LBW. If poor fetal growth is suspected, offer third-trimester ultrasound or serial growth studies as necessary to rule out IUGR. [II-2-B] [2019]

Fertility

Low BMI can contribute to menstrual irregularities and infertility problems, which may increase the difficulty of calculating an estimated due date by menstrual history alone, compared with people who have regular cycles. (122) Individuals with low BMI are also at a slightly increased risk for miscarriage compared with recommended-BMI individuals (RR 1.08 95% CI 1.05-1.11, p < 0.0001). (33)

RECOMMENDATION

17. Midwives should perform a thorough menstrual history with every client. For those who report menstrual irregularities, discuss the risks and benefits of a dating ultrasound, preferably prior to 14 weeks' gestation. [I-A] [2019]

CONCLUSION

This clinical practice guideline highlights some of the health complications that individuals with high or low BMI may face during and after pregnancy. It is important to note that not all individuals within a particular BMI category have an equal likelihood of experiencing complications. The possible consequences of labelling individuals high risk before any complications actually occur also need to be taken into account. High or low BMI on its own, without complications, is not cause to automatically categorize a client as high risk. When careful assessment of term-underweight pregnant people rules out SGA, IUGR and LBW infants, there is no increased risk compared with the risk for those within the recommended BMI. Likewise, among pregnant people who have a high BMI but do not exhibit any of the comorbidities discussed, and in whom the index of suspicion for an LGA or macrosomic infant is low, complications such as postpartum hemorrhage and caesarean section may not prove problematic.

Midwives should take particular care in discussions with high-BMI clients, as qualitative research demonstrates that these individuals often experience labelling, stereotyping and discrimination from health care professionals during their pregnancies. Participants in this research have reported that health care providers often avoid discussions about obesity, make assumptions about the participants' lack of physical ability, and focus specifically on the health of the fetus, disregarding the pregnant parent's feelings or experience. These findings emphasize how the perception of high-BMI clients as high risk for medical intervention is disempowering, and may result in poor care, over-treatment or over-diagnosis within this population. (123)

Although discussion about BMI can be challenging, midwives can still provide thoughtful support and positive reinforcement throughout pregnancy and postpartum for clients with high or low BMI. When appropriate, comments regarding weight should involve the sensitive use of language and should be clear and carefully explained within the context of the client's unique clinical picture.

Each client deserves to be given an individualized care plan, which may or may not include issues related to BMI. An appropriate approach is to offer a realistic discussion about the risks associated with high or low BMI, the significance of complications should they develop, and an assessment of the midwife's ability to respond to them.

SUMMARY OF RECOMMENDATIONS

1. Offer referral to the most appropriate and available mental health services for clients who have or are suspected of having an eating disorder. [III-C] [2010]

2. Discuss the benefits of optimizing GWG in pregnancy for clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2. [II-2-B] [new 2019]

3. Midwives may consider calculating and documenting pre-pregnancy BMI on the first antenatal record. If pre-pregnancy weight is unknown, midwives may consider documenting BMI at the intake visit. [III-B] [new 2019]

4. All clients should be counselled about the importance of good nutrition and physical activity during pregnancy. Canada's Food Guide is an example of a nutrition guideline that includes dietary advice for individuals who are pregnant or nursing. [II-2-B] [2010]

5. For clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2, midwives should identify and offer referrals to the most appropriate health care providers available in clients' communities to discuss nutrition, healthy eating and other good habits. [II-2-B] [2010]

High BMI

6. Obtain and document a baseline blood pressure, using the appropriate cuff size for clients with a BMI ≥ 30 kg/m^2. [II-2-B] [2019]

7. For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the higher risk of preeclampsia and GDM, along with the risks and benefits of GDM screening. [II-2-A] [new 2019]

8. Midwives should individually evaluate each client's need for thromboprophylaxis. They may consider offering an antepartum consultation with a physician for clients with a BMI ≥ 40 kg/m^2, or for clients with a BMI ≥ 30 kg/m^2 and other known risk factors for thromboembolism. [III-C] [new 2019]

9. For second-trimester ultrasounds reporting suboptimal visualization, discuss limitations of ultrasound with client and consider offering repeat ultrasound if needed. [III-B] [2019]

10. When abdominal palpation proves challenging and/or symphysis-fundal measurements are unreliable, midwives should discuss risks and benefits of a third-trimester ultrasound and offer as necessary to address any information gaps. [II-2-B] [2019]

11. Midwives should consider offering an antepartum anesthesiology consultation for clients who plan an epidural, or for those who wish to have a more detailed discussion about potential anesthesia complications related to BMI ≥ 30 kg/m^2. [III-C] [2019]

12. Midwives are well suited to help clients with a BMI ≥ 30 kg/m^2 who may experience difficulties with nursing to establish good positioning, latch and milk supply. When appropriate, midwives should refer clients to a lactation consultant or other specialist for lactation support. [III-B] [2019]

13. For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the benefits of a diet high in nutrient-dense, folate-containing foods before and during pregnancy to reduce the risk of NTDs. For clients who cannot maintain a high-folate diet, midwives may also discuss the risks and benefits of administering a supplement with 0.4 mg to 5 mg of folic acid. [II-2-B] [new 2019]

14. Midwives should ensure that they feel competent to perform venipuncture and gain IV access in clients with a BMI ≥ 30 kg/m^2, and may consider establishing IV access during labour in clients who choose home birth. [III-C] [2010]

15. BMI ≥ 30 kg/m^2 alone is not an indicator for hospital birth. Midwives should support choice of birthplace for clients with a BMI ≥ 30 kg/m^2. [II-2-B] [new 2019]

Low BMI

16. Clients with a BMI < 18.5 kg/m^2 are at higher risk of IUGR, SGA and LBW. If poor fetal growth is suspected, offer third-trimester ultrasound or serial growth studies as necessary to rule out IUGR. [II-2-B] [2019]

17. Midwives should perform a thorough menstrual history with every client. For clients who report menstrual irregularities, discuss the risks and benefits of a dating ultrasound, preferably prior to 14 weeks' gestation. [I-A] [2019]

REFERENCES

1. The AGREE Collaboration. Appraisal of Guidelines for Research & Evaluation (AGREE) Instrument. [Internet]. 2001. Available from: www.agreecollaboration.org

2. Association of Ontario Midwives. Collated Response: A Values Based Approach to CPG Development [Internet]. 2006. p. 3. Available from: https://www.ontariomidwives.ca/values-based-approach-cpg-development

3. Canadian Task Force on Preventive Health Care. New grades for recommendations from the Canadian Task Force on Preventive Health Care. CMAJ [Internet]. 2003 Aug 5;169(3):207–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12900479

4. Krishnamoorthy U, Schram CMH, Hill SR. Maternal obesity in pregnancy: Is it time for meaningful research to inform preventive and management strategies? BJOG [Internet]. 2006 Oct;113(10):1134–40. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16972858

5. Rasmussen K, Yaktine AL. Weight Gain During Pregnancy: Reexamining the Guidelines. [Internet]. Medicine I of, editor. Weight Gain During Pregnancy: Reexamining the Guidelines. The National Academies Press; 2009. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20669500

6. Tomiyama AJ, Hunger JM, Nguyen-Cuu J, Wells C. Misclassification of cardiometabolic health when using body mass index categories in NHANES 2005-2012. Int J Obes [Internet]. 2016;40(5):883–6. Available from: http://dx.doi.org/10.1038/ijo.2016.17

7. Després J-P, Lemieux I. Abdominal obesity and metabolic syndrome. Nature [Internet]. 2006 Dec 14;444(7121):881–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17167477

8. Pan W-H, Flegal KM, Chang H-Y, Yeh W-T, Yeh C-J, Lee W-C. Body mass index and obesity-related metabolic disorders in Taiwanese and US whites and blacks: implications for definitions of overweight and obesity for Asians. Am J Clin Nutr [Internet]. 2004 Jan;79(1):31–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14684394

9. Deurenberg-Yap M, Schmidt G, van Staveren WA, Deurenberg P. The paradox of low body mass index and high body fat percentage among Chinese, Malays and Indians in Singapore. Int J Obes Relat Metab Disord [Internet]. 2000 Aug;24(8):1011–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10951540

10. Index WHOGD on BM. BMI classification. Vol. 2010. 2006.

11. Rolls BJ. The Supersizing of America: Portion Size and the Obesity Epidemic. Nutr Today [Internet]. 38(2):42–53. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12698053

12. Andersen AE, Ryan GL. Eating disorders in the obstetric and gynecologic patient population. Obstet Gynecol [Internet]. 2009 Dec;114(6):1353–67. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19935043

13. The Human Face of Mental Health and Mental Illness in Canada 2006 [Internet]. 2006. Available from: http://www.phac-aspc.gc.ca/publicat/human-humain06/pdf/human_face_e.pdf

14. Zhu AJ, Walsh BT. Pharmacologic treatment of eating disorders. Can J Psychiatry [Internet]. 2002 Apr;47(3):227–34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11987473

15. Mitchell AM, Bulik CM. Eating disorders and women's health: an update. J Midwifery Womens Health [Internet]. 51(3):193–201. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16647671

16. Goldstein RF, Abell SK, Ranasinha S, Misso M, Boyle JA, Black MH, et al. Association of Gestational Weight Gain With Maternal and Infant Outcomes: A Systematic Review and Meta-analysis. JAMA [Internet]. 2017 Jun 6;317(21):2207–25. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28586887

17. Herring SJ, Oken E, Haines J, Rich-Edwards JW, Rifas-Shiman SL, Kleinman ScD KP, et al. Misperceived pre-pregnancy body weight status predicts excessive gestational weight gain: findings from a US cohort study. BMC Pregnancy Childbirth [Internet]. 2008 Dec 22;8:54. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19102729

18. Volger S, Vetter ML, Dougherty M, Panigrahi E, Egner R, Webb V, et al. Patients' preferred terms for describing their excess weight: discussing obesity in clinical practice. Obesity (Silver Spring) [Internet]. 2012 Jan;20(1):147–50. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21760637

19. Dodd JM, Crowther CA, Robinson JS. Dietary and lifestyle interventions to limit weight gain during pregnancy for obese or overweight women: a systematic review. Acta Obstet Gynecol Scand [Internet]. 2008;87(7):702–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18607830

20. Santos IA, Stein R, Fuchs SC, Duncan BB, Ribeiro JP, Kroeff LR, et al. Aerobic exercise and submaximal functional capacity in overweight pregnant women: a randomized trial. Obstet Gynecol [Internet]. 2005 Aug;106(2):243–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16055571

21. Reece EA. Obesity, diabetes, and links to congenital defects: a review of the evidence and recommendations for intervention. J Matern Fetal Neonatal Med [Internet]. 2008 Mar;21(3):173–80. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18297572

22. Walker R, Bennett C, Blumfield M, Gwini S, Ma J, Wang F, et al. Attenuating Pregnancy Weight Gain-What Works and Why: A Systematic Review and Meta-Analysis. Nutrients [Internet]. 2018 Jul 22;10(7). Available from: http://www.ncbi.nlm.nih.gov/pubmed/30037126

23. Shin D, Bianchi L, Chung H, Weatherspoon L, Song WO. Is gestational weight gain associated with diet quality during pregnancy? Matern Child Health J [Internet]. 2014 Aug;18(6):1433–43. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24162550

24. Fowles ER, Fowles SL. Healthy eating during pregnancy: determinants and supportive strategies. J Community Health Nurs [Internet]. 2008;25(3):138–52. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18709575

25. Clapp JF. Exercise during pregnancy. A clinical update. Clin Sports Med [Internet]. 2000 Apr;19(2):273–86. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10740759

26. Mottola MF, Davenport MH, Ruchat SM, Davies GA, Poitras V, Gray C, et al. No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy. J Obstet Gynaecol Canada [Internet]. 2018;40(11):1528–37. Available from: https://doi.org/10.1016/j.jogc.2018.07.001

27. Stuebe AM, Oken E, Gillman MW. Associations of diet and physical activity during pregnancy with risk for excessive gestational weight gain. Am J Obstet Gynecol [Internet]. 2009 Jul 19;201(1):58.e1-8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19467640

28. Institutes of Health Obesity Research Task Force N. NIH Obesity Research a Report of the NIH Obesity Research Task Force. 2011; Available from: https://obesityresearch.nih.gov/about/StrategicPlanforNIH_Obesity_Research_Full-Report_2011.pdf

29. Organization WH. Obesity: Preventing and managing the global epidemic [Internet]. Vol. 894, World Health Organization technical report series. 1999. Available from: http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

30. Statistics Canada. Canadian health characteristics, annual estimates [Internet]. 2018. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1310009601#timeframe

31. Abdelmalek MZ, Guest S, Maxwell C. Team Planning in Obstetrical Care for Women With Obesity. J Obstet Gynaecol Canada [Internet]. 2019;41(3):338–43. Available from: https://doi.org/10.1016/j.jogc.2018.06.017

32. Beyerlein A, Schiessl B, Lack N, von Kries R. Optimal gestational weight gain ranges for the avoidance of adverse birth weight outcomes: a novel approach. Am J Clin Nutr [Internet]. 2009 Dec;90(6):1552–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19812177

33. Balsells M, García-Patterson A, Corcoy R. Systematic review and meta-analysis on the association of prepregnancy underweight and miscarriage. Eur J Obstet Gynecol Reprod Biol [Internet]. 2016 Dec;207:73–9. Available from: http://dx.doi.org/10.1016/j.ejogrb.2016.10.012

34. Marchi J, Berg M, Dencker A, Olander EK, Begley C. Risks associated with obesity in pregnancy, for the mother and baby: A systematic review of reviews. Obes Rev. 2015;16(8):621–38.

35. Carlson NS, Lowe NK. Intrapartum management associated with obesity in nulliparous women. J Midwifery Women's Heal. 2014;59(1):43–53.

36. Poorolajal J, Jenabi E. The association between body mass index and preeclampsia: a meta-analysis. J Matern Neonatal Med [Internet]. 2016;29(22):3670–6. Available from: https://www.tandfonline.com/doi/full/10.3109/14767058.2016.1140738

37. Lutsiv O, Mah J, Beyene J, McDonald SD. The effects of morbid obesity on maternal and neonatal health outcomes: A systematic review and meta-analyses. Obes Rev. 2015;16(7):531–46.

38. Baeten JM, Bukusi EA, Lambe M. Pregnancy complications and outcomes among overweight and obese nulliparous women. Am J Public Health [Internet]. 2001 Mar;91(3):436–40. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11236410

39. Robinson HE, O'Connell CM, Joseph KS, McLeod NL. Maternal outcomes in pregnancies complicated by obesity. Obstet Gynecol [Internet]. 2005 Dec;106(6):1357–64. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16319263

40. Cedergren MI. Maternal morbid obesity and the risk of adverse pregnancy outcome. Obstet Gynecol [Internet]. 2004 Feb;103(2):219–24. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14754687

41. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. Int J Obes Relat Metab Disord [Internet]. 2001 Aug;25(8):1175–82. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=N&PAGE=fulltext&AN=11477502&D=med4

42. Nohr EA, Bech BH, Davies MJ, Frydenberg M, Henriksen TB, Olsen J. Prepregnancy obesity and fetal death: a study within the Danish National Birth Cohort. Obstet Gynecol [Internet]. 2005 Aug;106(2):250–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16055572

43. Abenhaim HA, Kinch RA, Morin L, Benjamin A, Usher R. Effect of prepregnancy body mass index categories on obstetrical and neonatal outcomes. Arch Gynecol Obstet. 2007 Jan;275(1):39–43.

44. Steinfeld JD, Valentine S, Lerer T, Ingardia CJ, Wax JR, Curry SL. Obesity-related complications of pregnancy vary by race. J Matern Fetal Med [Internet]. 2000;9(4):238–41. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11048836

45. Pathi A, Esen U, Hildreth A. A comparison of complications of pregnancy and delivery in morbidly obese and non-obese women. J Obstet Gynaecol [Internet]. 2006 Aug;26(6):527–30. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17000498

46. Walsh SW. Obesity: a risk factor for preeclampsia. Trends Endocrinol Metab [Internet]. 2007 Dec;18(10):365–70. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18023357

47. Bodnar LM, Catov JM, Klebanoff MA, Ness RB, Roberts JM. Prepregnancy body mass index and the occurrence of severe hypertensive disorders of pregnancy. Epidemiology [Internet]. 2007 Mar;18(2):234–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17237733

48. O'Brien TE, Ray JG, Chan W-S. Maternal body mass index and the risk of preeclampsia: a systematic overview. Epidemiology [Internet]. 2003 May;14(3):368–74. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12859040

49. Bartsch E, Medcalf KE, Park AL, Ray JG. Clinical risk factors for pre-eclampsia determined in early pregnancy: systematic review and meta-analysis of large cohort studies. BMJ [Internet]. 2016;i1753. Available from: http://www.bmj.com/lookup/doi/10.1136/bmj.i1753

50. Flenady V, Koopmans L, Middleton P, Frøen JF, Smith GC, Gibbons K, et al. Major risk factors for stillbirth in high-income countries: A systematic review and meta-analysis. Lancet [Internet]. 2011;377(9774):1331–40. Available from: http://dx.doi.org/10.1016/S0140-6736(10)62233-7

51. Vitner D, Harris K, Maxwell C, Farine D. Obesity in pregnancy: a comparison of four national guidelines. J Matern Neonatal Med [Internet]. 2018;0(0):1–11. Available from: https://doi.org/10.1080/14767058.2018.1440546

52. Palatini P, Parati G. Blood pressure measurement in very obese patients: a challenging problem. J Hypertens. 2011;29(3):425–9.

53. Roberge S, Nicolaides K, Demers S, Hyett J, Chaillet N, Bujold E. The role of aspirin dose on the prevention of preeclampsia and fetal growth restriction: systematic review and meta-analysis. Am J Obstet Gynecol. 2017;216(2):110–120.e6.

54. Coroyannakis C, Khalil A. Management of Hypertension in the Obese Pregnant Patient. Curr Hypertens Rep. 2019;21(3):1–7.

55. HDP CPG Working Group. Association of Ontario Midwives. Hypertensive disorders of pregnancy (Clinical Practice Guideline no. 15). 2012.

56. Tieu J, McPhee AJ, Crowther CA, Middleton P. Screening and subsequent management for gestational diabetes for improving maternal and infant health. Cochrane database Syst Rev [Internet]. 2014 Feb 11 [cited 2015 Jan 13];2(2):CD007222. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24515533

57. Kehler S, MacDonald T, Meuser A, Darling L, Cates E, Bourgeois C, et al. GESTATIONAL DIABETES MELLITUS: A review for midwives. 2016;1–31. Available from: https://www.ontariomidwives.ca/sites/default/files/Gestational-diabetes-mellitus-background-er-PUB_0.pdf

58. Blondon M, Harrington LB, Boehlen F, Robert-Ebadi H, Righini M, Smith NL. Pre-pregnancy BMI, delivery BMI, gestational weight gain and the risk of postpartum venous thrombosis. Thromb Res [Internet]. 2016;145:151–6. Available from: http://dx.doi.org/10.1016/j.thromres.2016.06.026

59. Kevane B, Donnelly J, D'Alton M, Cooley S, Preston RJS, Áinle FN. Risk factors for pregnancy-associated venous thromboembolism: A review. J Perinat Med. 2014;42(4):417–25.

60. RCOG. Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium Green-top Guideline No. 37a. RCOG Press. 2015;(37):1–40.

61. Centre for Maternal and Child Enquiries, Royal College of Obstetricians and Gynaecologists. CMACE/RCOG Joint Guideline: Management of Women with Obesity in Pregnancy. Obesity Reviews. 2010.

62. Davies GAL, Maxwell C, McLeod NL. SOGC Clinical Practice Guideline: Obesity in Pregnancy. Int J Gynaecol Obstet. 2010;110(2):167–73.

63. Hendler I, Blackwell SC, Bujold E, Treadwell MC, Wolfe HM, Sokol RJ, et al. The impact of maternal obesity on midtrimester sonographic visualization of fetal cardiac and craniospinal structures. Int J Obes Relat Metab Disord [Internet]. 2004 Dec;28(12):1607–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15303105

64. Ramachenderan J, Bradford J, McLean M. Maternal obesity and pregnancy complications: a review. Aust N Z J Obstet Gynaecol [Internet]. 2008 Jun;48(3):228–35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18532950

65. Denison FC, Aedla NR, Keag O, Hor K, Reynolds RM, Milne A, et al. Care of Women with Obesity in Pregnancy: Green-top Guideline No. 72. BJOG An Int J Obstet Gynaecol. 2019;126(3):e62–106.

66. Cohen WR, Hayes-Gill B. Influence of maternal body mass index on accuracy and reliability of external fetal monitoring techniques. Acta Obstet Gynecol Scand [Internet]. 2014 Jun [cited 2014 Jul 20];93(6):590–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24684703

67. Catalano PM, Ehrenberg HM. The short- and long-term implications of maternal obesity on the mother and her offspring. BJOG [Internet]. 2006 Oct;113(10):1126–33. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16827826

68. Soens MA, Birnbach DJ, Ranasinghe JS, van Zundert A. Obstetric anesthesia for the obese and morbidly obese patient: an ounce of prevention is worth more than a pound of treatment. Acta Anaesthesiol Scand [Internet]. 2008 Jan;52(1):6–19. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18173431

69. Heslehurst N, Simpson H, Ells LJ, Rankin J, Wilkinson J, Lang R, et al. The impact of maternal BMI status on pregnancy outcomes with immediate short-term obstetric resource implications: a meta-analysis. Obes Rev [Internet]. 2008 Nov;9(6):635–83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18673307

70. Siega-Riz A-M, Siega-Riz A-M, Laraia B. The implications of maternal overweight and obesity on the course of pregnancy and birth outcomes. Matern Child Health J [Internet]. 2006 Sep;10(5 Suppl):S153-6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16927160

71. Smith GCS, Shah I, Pell JP, Crossley JA, Dobbie R. Maternal obesity in early pregnancy and risk of spontaneous and elective preterm deliveries: a retrospective cohort study. Am J Public Health [Internet]. 2007 Jan;97(1):157–62. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17138924

72. Nohr EA, Vaeth M, Baker JL, Sørensen TI, Olsen J, Rasmussen KM. Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. Am J Clin Nutr [Internet]. 2008 Jun;87(6):1750–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18541565

73. Faria-Schützer DB, Surita FG, Nascimento SL, Vieira CM, Turato E. Psychological issues facing obese pregnant women: a systematic review. J Matern Neonatal Med [Internet]. 2017;30(1):88–95. Available from: https://www.tandfonline.com/doi/full/10.3109/14767058.2016.1163543

74. Anderson V, Chaboyer W, Gillespie B. The relationship between obesity and surgical site infections in women undergoing caesarean sections: An integrative review. Midwifery [Internet]. 2013;29(12):1331–8. Available from: http://dx.doi.org/10.1016/j.midw.2012.12.012

75. Arendas K, Qiu Q, Gruslin A. Obesity in pregnancy: pre-conceptional to postpartum consequences. J Obstet Gynaecol Can [Internet]. 2008 Jun;30(6):477–88. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18611299

76. Rasmussen KM, Hilson JA, Kjolhede CL. Obesity as a risk factor for failure to initiate and sustain lactation. Adv Exp Med Biol [Internet]. 2002 May;503(5):217–22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15121990

77. Baker JL, Michaelsen KF, Sørensen TIA, Rasmussen KM. High prepregnant body mass index is associated with early termination of full and any breastfeeding in Danish women. Am J Clin Nutr [Internet]. 2007 Aug;86(2):404–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17684212

78. Viswanathan M, Siega-Riz AM, Moos MK, Deierlein A, Mumford S, Knaack J, et al. Outcomes of maternal weight gain. Evid Rep Technol Assess (Full Rep) [Internet]. 2008 May;(168):1–223. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18620471

79. Amir LH, Donath S. A systematic review of maternal obesity and breastfeeding intention, initiation and duration. BMC Pregnancy Childbirth [Internet]. 2007 Jul 4;7:9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17608952

80. Liu P, Xu L, Wang Y, Zhang Y, Du Y, Sun Y, et al. Association between perinatal outcomes and maternal pre-pregnancy body mass index. Obes Rev [Internet]. 2016;17(11):1091–102. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27536879

81. Zhu Y, Chen Y, Feng Y, Yu D, Mo X. Association between maternal body mass index and congenital heart defects in infants: A meta-analysis. Congenit Heart Dis [Internet]. 2018 Mar;13(2):271–81. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29363266

82. Blanco R, Colombo A, Suazo J. Maternal obesity is a risk factor for orofacial clefts: A meta-analysis. Br J Oral Maxillofac Surg [Internet]. 2015;53(8):699–704. Available from: http://dx.doi.org/10.1016/j.bjoms.2015.05.017

83. Meehan S, Beck CR, Mair-Jenkins J, Leonardi-Bee J, Puleston R. Maternal Obesity and Infant Mortality: A Meta-Analysis. Pediatrics [Internet]. 2014;133(5):863–71. Available from: http://pediatrics.aappublications.org/cgi/doi/10.1542/peds.2013-1480

84. Huang HY, Chen HL, Feng LP. Maternal obesity and the risk of neural tube defects in offspring: A meta-analysis. Obes Res Clin Pract [Internet]. 2017;11(2):188–97. Available from: http://dx.doi.org/10.1016/j.orcp.2016.04.005

85. Gaudet L, Ferraro ZM, Wen SW, Walker M. Maternal Obesity and Occurrence of Fetal Macrosomia : A Systematic Review and Meta-Analysis. 2014;2014.

86. Yu Z, Han S, Zhu J, Sun X, Ji C, Guo X. Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. PLoS One [Internet]. 2013;8(4):e61627. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23613888

87. Dietz PM, Callaghan WM, Smith R, Sharma AJ. Low pregnancy weight gain and small for gestational age: a comparison of the association using 3 different measures of small for gestational age. Am J Obstet Gynecol [Internet]. 2009 Jul;201(1):53.e1-7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19576374

88. Rosenberg TJ, Garbers S, Lipkind H, Chiasson MA. Maternal obesity and diabetes as risk factors for adverse pregnancy outcomes: differences among 4 racial/ethnic groups. Am J Public Health [Internet]. 2005 Sep;95(9):1545–51. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16118366

89. Edwards LE, Hellerstedt WL, Alton IR, Story M, Himes JH. Pregnancy complications and birth outcomes in obese and normal-weight women: effects of gestational weight change. Obstet Gynecol [Internet]. 1996 Mar;87(3):389–94. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8598961

90. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate--a population-based screening study. Am J Obstet Gynecol [Internet]. 2004 Apr;190(4):1091–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15118648

91. Sheiner E, Levy A, Menes TS, Silverberg D, Katz M, Mazor M. Maternal obesity as an independent risk factor for caesarean delivery. Paediatr Perinat Epidemiol [Internet]. 2004 May;18(3):196–201. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15130159

92. Schrauwers C, Dekker G. Maternal and perinatal outcome in obese pregnant patients. J Matern Fetal Neonatal Med [Internet]. 2009 Mar;22(3):218–26. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=N&PAGE=fulltext&AN=19330705&D=prem

93. De Wals P, Tairou F, Van Allen MI, Uh S-H, Lowry RB, Sibbald B, et al. Reduction in neural-tube defects after folic acid fortification in Canada. N Engl J Med [Internet]. 2007 Jul 12;357(2):135–42. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17625125

94. Rasmussen SA, Chu SY, Kim SY, Schmid CH, Lau J. Maternal obesity and risk of neural tube defects: a metaanalysis. Am J Obstet Gynecol [Internet]. 2008 Jun;198(6):611–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18538144

95. McMahon DM, Liu J, Zhang H, Torres ME, Best RG. Maternal obesity, folate intake, and neural tube defects in offspring. Birth Defects Res A Clin Mol Teratol [Internet]. 2013 Feb;97(2):115–22. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23404872

96. da Silva VR, Hausman DB, Kauwell GPA, Sokolow A, Tackett RL, Rathbun SL, et al. Obesity affects short-term folate pharmacokinetics in women of childbearing age. Int J Obes (Lond) [Internet]. 2013 Dec;37(12):1608–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23567925

97. Maffoni S, De Giuseppe R, Stanford FC, Cena H. Folate status in women of childbearing age with obesity: a review. Nutr Res Rev [Internet]. 2017 Dec;30(2):265–71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28587698

98. Wang M, Wang Z-P, Gao L-J, Gong R, Sun X-H, Zhao Z-T. Maternal body mass index and the association between folic acid supplements and neural tube defects. Acta Paediatr [Internet]. 2013 Sep;102(9):908–13. Available from: http://doi.wiley.com/10.1111/apa.12313

99. Stern SJ, Matok I, Kapur B, Koren G. Dosage requirements for periconceptional folic acid supplementation: accounting for BMI and lean body weight. J Obstet Gynaecol Can [Internet]. 2012 Apr;34(4):374–8. Available from: http://dx.doi.org/10.1016/S1701-2163(16)35220-3

100. Dietitians of Canada. Food Sources of Folate [Internet]. 2014. Available from: https://www.dietitians.ca/getattachment/8612a7a9-642d-42dd-8e38-33f908c26c6a/FACTSHEET-Food-Sources-of-Folate.pdf.aspx

101. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists. Management of Obesity in Pregnancy [Internet]. 2013. Available from: https://www.ranzcog.edu.au/RANZCOG_SITE/media/RANZCOG-MEDIA/Women%27s Health/Statement and guidelines/Clinical-Obstetrics/Management-of-obesity-(C-Obs-49)-Review-March-2017.pdf?ext=.pdf

102. Health Canada. Prenatal Nutrition Guidelines for Health Professionals, Gestational Weight Gain. Http://WwwHc-ScGcCa/Fn-an/Alt_Formats/Pdf/Nutrition/Prenatal/Ewba-Mbsa-EngPdf. 2010;Accessed January 2013.

103. Rosenthal K. Selecting the best i.v. site for an obese patient. Nursing (Lond) [Internet]. 2004 Nov;34(11):14. Available from: https://journals.lww.com/nursing/Citation/2004/11000/Selecting_the_best_I_V__site_for_an_obese_patient.11.aspx

104. Hollowell J, Pillas D, Rowe R, Linsell L, Knight M, Brocklehurst P. The impact of maternal obesity on intrapartum outcomes in otherwise low risk women: Secondary analysis of the Birthplace national prospective cohort study. BJOG An Int J Obstet Gynaecol. 2014;121(3):343–55.

105. Nunes VD, Gholitabar M, Sims JM, Bewley S. Intrapartum care of healthy women and their babies: Summary of updated NICE guidance. BMJ [Internet]. 2014;349(December):1–9. Available from: http://dx.doi.org/doi:10.1136/bmj.g6886

106. Rowe R, Knight M, Kurinczuk JJ, UK Midwifery Study System (UKMidSS). Outcomes for women with BMI > 35 kg/m^2 admitted for labour care to alongside midwifery units in the UK: A national prospective cohort study using the UK Midwifery Study System (UKMidSS). PLoS One [Internet]. 2018;13(12):e0208041. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30513088

107. Birthplace in England Collaborative Group, Brocklehurst P, Hardy P, Hollowell J, Linsell L, Macfarlane A, et al. Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. BMJ [Internet]. 2011 Nov 23;343(November):d7400. Available from: http://dx.doi.org/10.1136/bmj.d7400

108. Statistics Canada. Measured adult body mass index (BMI) [Internet]. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1310045601

109. Gilmore J. Body mass index and health. Heal reports [Internet]. 1999;11(1):31–43(Eng); 33–47(Fre). Available from: http://www.ncbi.nlm.nih.gov/pubmed/11965822

110. Lartey A. Maternal and child nutrition in Sub-Saharan Africa: challenges and interventions. Proc Nutr Soc [Internet]. 2008 Feb;67(1):105–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18234138

111. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet (London, England) [Internet]. 2008 Jan 19;371(9608):243–60. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18207566

112. Belogolovkin V, Eddleman KA, Malone FD, Sullivan L, Ball RH, Nyberg DA, et al. The effect of low body mass index on the development of gestational hypertension and preeclampsia. J Matern Fetal Neonatal Med [Internet]. 2007 Jul;20(7):509–13. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17674263

113. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. BMC Public Health [Internet]. 2007 Jul 24;7:168. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17650297

114. Giovannini M, Radaelli G, Banderali G, Riva E. Low prepregnant body mass index and breastfeeding practices. J Hum Lact [Internet]. 2007 Feb;23(1):44–51. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17293550

115. Han Z, Mulla S, Beyene J, Liao G, McDonald SD. Maternal underweight and the risk of preterm birth and low birth weight : a systematic review and meta-analyses. 2011;(November 2010):65–101.

116. Cai GJ, Sun XX, Zhang L, Hong Q. Association between maternal body mass index and congenital heart defects in offspring: A systematic review. Am J Obstet Gynecol [Internet]. 2014;211(2):91–117. Available from: http://dx.doi.org/10.1016/j.ajog.2014.03.028

117. Dean S V., Lassi ZS, Imam AM, Bhutta ZA. Preconception care: Nutritional risks and interventions. Reprod Health. 2014;11(Suppl 3):1–15.

118. Ramakrishnan U, Grant F, Goldenberg T, Zongrone A, Martorell R. Effect of women's nutrition before and during early pregnancy on maternal and infant outcomes: a systematic review. Paediatr Perinat Epidemiol [Internet]. 2012 Jul;26 Suppl 1(SUPPL. 1):285–301. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22742616

119. Goto E. Dose-response association between maternal body mass index and small for gestational age: a meta-analysis. J Matern Fetal Neonatal Med [Internet]. 2017 Jan;30(2):213–8. Available from: https://www.tandfonline.com/doi/full/10.3109/14767058.2016.1169519

120. Barbieri MA, Portella AK, Silveira PP, Bettiol H, Agranonik M, Silva AA, et al. Severe intrauterine growth restriction is associated with higher spontaneous carbohydrate intake in young women. Pediatr Res [Internet]. 2009 Feb;65(2):215–20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19047956

121. Sharma D, Shastri S, Sharma P. Intrauterine Growth Restriction: Antenatal and Postnatal Aspects. Clin Med Insights Pediatr. 2016;10:CMPed.S40070.

122. Grodstein F, Goldman MB, Cramer DW. Body mass index and ovulatory infertility. Epidemiology [Internet]. 1994 Mar;5(2):247–50. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8173001

123. Furber CM, McGowan L. A qualitative study of the experiences of women who are obese and pregnant in the UK. Midwifery [Internet]. 2011;27(4):437–44. Available from: http://dx.doi.org/10.1016/j.midw.2010.04.001

124. Kakarla N, Dailey C, Marino T, Shikora SA, Chelmow D. Pregnancy after gastric bypass surgery and internal hernia formation. Obstet Gynecol [Internet]. 2005 May;105(5 Pt 2):1195–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15863579

125. Christou N V, Efthimiou E. Bariatric surgery waiting times in Canada. Can J Surg [Internet]. 2009 Jun;52(3):229–34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19503668

126. Edwards JE. Pregnancy after bariatric surgery. AWHONN lifelines [Internet]. 2005;9(5):388–93. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16359078

127. Guelinckx I, Devlieger R, Vansant G. Reproductive outcome after bariatric surgery: a critical review. Hum Reprod Update [Internet]. 2009;15(2):189–201. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19136457

128. Woodard CB. Pregnancy following bariatric surgery. J Perinat Neonatal Nurs [Internet]. 2004;18(4):329–40. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15646304

129. Ducarme G, Revaux A, Rodrigues A, Aissaoui F, Pharisien I, Uzan M. Obstetric outcome following laparoscopic adjustable gastric banding. Int J Gynaecol Obstet [Internet]. 2007 Sep;98(3):244–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17433814

130. Weintraub AY, Levy A, Levi I, Mazor M, Wiznitzer A, Sheiner E. Effect of bariatric surgery on pregnancy outcome. Int J Gynaecol Obstet [Internet]. 2008 Dec;103(3):246–51. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18768177

131. Grange DK, Finlay JL. Nutritional vitamin B12 deficiency in a breastfed infant following maternal gastric bypass. Pediatr Hematol Oncol [Internet]. 1994;11(3):311–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8060815

132. Karmon A, Sheiner E. Pregnancy after bariatric surgery: a comprehensive review. Arch Gynecol Obstet [Internet]. 2008 May;277(5):381–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18493884

133. Scaglione F, Panzavolta G. Folate, folic acid and 5-methyltetrahydrofolate are not the same thing. Xenobiotica. 2014;44(5):480–8.

134. Cedergren M, Källén B. Maternal obesity and the risk for orofacial clefts in the offspring. Cleft Palate Craniofac J [Internet]. 2005 Jul;42(4):367–71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16001917

135. Patel KR, Sobczyńska-Malefora A. The adverse effects of an excessive folic acid intake. Eur J Clin Nutr. 2017;71(2):159–63.

136. Prinz-Langenohl R, Brämswig S, Tobolski O, Smulders Y, Smith D, Finglas P, et al. [6S]-5-methyltetrahydrofolate increases plasma folate more effectively than folic acid in women with the homozygous or wild-type 677C□T polymorphism of methylenetetrahydrofolate reductase. Br J Pharmacol. 2009;158(8):2014–21.

137. Lamers Y, Prinz-Langenohl R, Brämswig S, Pietrzik K. Red blood cell folate concentrations increase more after supplementation with [6S]-5-methyltetrahydrofolate than with folic acid in women of childbearing age. Am J Clin Nutr [Internet]. 2006 Jul;84(1):156–61. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16825690

138. Houghton LA, Sherwood KL, Pawlosky R, Ito S, O'Connor DL. [6S]-5-Methyltetrahydrofolate is at least as effective as folic acid in preventing a decline in blood folate concentrations during lactation. Am J Clin Nutr [Internet]. 2006 Apr;83(4):842–50. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16600937

139. Fohr IP, Prinz-Langenohl R, Brönstrup A, Bohlmann AM, Nau H, Berthold HK, et al. 5,10-Methylenetetrahydrofolate reductase genotype determines the plasma homocysteine-lowering effect of supplementation with 5-methyltetrahydrofolate or folic acid in healthy young women. Am J Clin Nutr [Internet]. 2002 Feb;75(2):275–82. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11815318

APPENDIX

Table 1: Updated 2019 Recommendations, Summary Statements and Explanation of Changes*

Original Recommendation or Summary Statement from 2010	Updated Recommendation or Summary Statement [new 2019]	Explanation of Change(s)
Prevention of Poor Outcomes		
Recommendation Midwives should discuss the risks of excessive GWG in pregnancy for women with BMI ≥ 30. [II-2-B]	**Recommendation** Discuss the benefits of optimizing GWG in pregnancy for clients with a BMI < 18.5 kg/m^2 or ≥ 30 kg/m^2. [II-2-B] [new 2019]	• New systematic evidence was found suggesting that obesity- and underweight-related complications can be reduced or prevented to some extent through the careful management of weight gain during pregnancy. • The language of the new recommendation now addresses both low- and high-BMI populations.
Recommendation For women with BMI ≥ 30, discuss the benefits of achieving a normal BMI prior to the next conception. [II-2-B]	**Summary Statement** For clients with a BMI ≥ 30 kg/m^2, consider discussing the benefits of achieving a normal BMI prior to the next conception.	• This statement was changed from a recommendation to a summary statement, and some language was adjusted be less prescriptive. • These changes allow midwives to use their clinical discretion to determine which clients would benefit from a discussion about future weight loss.
Recommendation Calculate and document pre-pregnancy BMI on the first antenatal record. [II-2B] If pre-pregnancy weight is unknown, document BMI at the intake visit. [III-B]	**Recommendation** Midwives may consider calculating and documenting pre-pregnancy BMI on the first antenatal record. If pre-pregnancy weight is unknown, midwives may consider documenting BMI at the intake visit. [III-B] [new 2019]	• The language of the new recommendation was adjusted to be less prescriptive than the original. • The new recommendation recognizes that not all Ontario midwives will choose to document and calculate BMI based on client preferences.
Antenatal and Intrapartum Complications: High BMI		
Recommendation For women with BMI ≥ 30, midwives should discuss the increased risk of gestational diabetes mellitus (GDM) along with the risks and benefits of GDM screening. [II-2-A]	**Recommendation** For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the higher risk of preeclampsia and GDM, along with the risks and benefits of GDM screening. [II-2-A] [new 2019]	• Preeclampsia and gestational diabetes mellitus were both found to be moderate risk factors for pregnant people with a high-BMI. • Preeclampsia was included in this recommendation to reflect that it is another moderate risk factor for pregnant people with a high-BMI.
Recommendation Obesity is a moderate risk factor for thromboembolism. Women with BMI ≥ 30 undergoing caesarean section should be encouraged to discuss options for thromboprophylaxis with their consulting obstetrician. [II-2-B]	**Recommendation** Midwives should individually evaluate each client's need for thromboprophylaxis. They may consider offering an antepartum consultation with a physician for clients with a BMI ≥ 40 kg/m^2, or for clients with a BMI ≥ 30 kg/m^2 and other known risk factors for thromboembolism. [III-C] [new 2019]	• Available literature on thromboembolism was inconclusive on a specific course of action for all high-BMI individuals. However, the presence of a very high BMI and/or other risk factors for thromboembolism are likely to influence clinical decision-making. • Opinions of respected authorities (i.e., other clinical practice guideline development groups) were referred to in the absence of well-designed, systematic evidence. • Evaluation of the evidence and classification of the recommendation was adjusted to reflect these changes.

Table 1: Updated 2019 Recommendations, Summary Statements and Explanation of Changes*		
Original Recommendation or Summary Statement from 2010	Updated Recommendation or Summary Statement [new 2019]	Explanation of Change(s)

Recommendation
 	
All women with BMI ≥ 30 should have an informed choice discussion of increased risks during labour. The following should be included as part of the informed choice discussion:
• Increased risk of fetal macrosomia [II-2-B]
• Increased risk of postpartum hemorrhage[II-2-B]
• Increased difficulty of ausculating the fetal heart [II-2-B] and the potential need for internal fetal heart rate monitoring [III-C]
• Increased risk of having a missed abnormality on ultrasound (NTD) [II-2-B]
• Increased risk of stillbirth [II-2-B]
 	
Midwives should support the choice of birthplace for women with BMI > 30 once increased risks have been discussed.
	Summary Statement
	
	Midwives may consider offering continuous fetal heart rate monitoring to clients with a high-BMI in whom fetal heart rate is difficult to detect using intermittent auscultation. [new 2019]
		• This recommendation was separated into two new summary statements and a new recommendation. *[See the section Fetal and Neonatal Complications: High BMI in this table for another summary statement; and Midwifery-Specific Considerations: High BMI in this table for the new recommendation.]*
		• This summary statement isolates the portion of the original recommendation pertaining to fetal heart rate monitoring, to improve clarity.
		• Discussion on fetal heart rate monitoring was changed from a recommendation to a summary statement due to a lack of evidence to support continuous FHR monitoring during labour for clients with high BMI.
		• There was a lack of evidence on the specific need for internal fetal heart rate monitoring with high-BMI clients.
		• The portion of the original recommendation pertaining to fetal macrosomia has been moved to the Fetal and Neonatal Complications: High BMI section of the BMI CPG. *[See the section Fetal and Neonatal Complications: High BMI in this table for an explanation on this change.]*
		• The portion of the original recommendation pertaining to the increased risk for postpartum hemorrhage (PPH) was removed due to a lack of recent systematic evidence on PPH risk for high-BMI clients.
		  • The most recent meta-analysis found a mild risk for PPH among high-BMI pregnancies.
		  • The risk of PPH for high-BMI clients has been included in Table 4b of the CPG and is discussed in the Choice of Birthplace section of the CPG. However, a recommendation specific to this topic was deemed unnecessary.
		• The portion of the original recommendation pertaining to missed NTD abnormality on ultrasound was removed due to a lack of available evidence on this topic and a mild risk for NTDs in high-BMI pregnancies.
		• The portion of the original recommendation pertaining to stillbirth was removed due to recent research that demonstrated a mild risk for this outcome in high-BMI individuals.
		• The portion of the original recommendation pertaining to home birth was separated into its own recommendation to increase clarity and readability. *[See the section Midwifery-Specific Considerations: High BMI in this table for an explanation of this change.]*

Table 1: Updated 2019 Recommendations, Summary Statements and Explanation of Changes*		
Original Recommendation or Summary Statement from 2010	Updated Recommendation or Summary Statement [new 2019]	Explanation of Change(s)
Fetal and Neonatal Complications: High BMI		
Recommendation All women with BMI ≥ 30 should have an informed choice discussion of increased risks during labour. The following should be included as part of the informed choice discussion: • Increased risk of fetal macrosomia [II-2-B] • Increased risk of postpartum hemorrhage[II-2-B] • Increased difficulty of ausculating the fetal heart [II-2-B] and the potential need for internal fetal heart rate monitoring [III-C] • Increased risk of having a missed abnormality on ultrasound (NTD) [II-2-B] • Increased risk of stillbirth [II-2-B] Midwives should support the choice of birthplace for women with BMI > 30 once increased risks have been discussed.	**Summary Statement** Clients with a BMI ≥ 30 kg/m^2 would benefit from informed choice discussions about the increased risk for fetal macrosomia and LGA, and the associated complications this may have during labour and birth. [new 2019]	• This recommendation was separated into two new summary statements and a new recommendation. *[See the section Antenatal and Intrapartum Complications: High BMI in this table for another summary statement; and the Midwifery-Specific Considerations: High BMI in this table for the new recommendation.]* • This new summary statement isolates the portion of the original recommendation pertaining to fetal macrosomia • This summary statement was necessary to include because of the mild-to-moderate risk for large fetuses and infants among high-BMI pregnant people, as demonstrated in recent systematic research. • *[See the section Antenatal and Intrapartum Complication: High BMI in this table for an explanation of all other changes to the original recommendation.]*

Table 1: Updated 2019 Recommendations, Summary Statements and Explanation of Changes*		
Original Recommendation or Summary Statement from 2010	Updated Recommendation or Summary Statement [new 2019]	Explanation of Change(s)
Summary Statement Women with BMI > 35 are at increased risk of having a fetus with NTD. Research concerning folic acid supplementation for women with BMI > 35 is conflicting. Research has not shown that increased intake of folic acid in overweight and obese women results in a similar drop in NTDs as compared to ideal BMI women. Folic acid is considered safe in pregnancy for both mother and fetus. It is a water-soluble vitamin and excess is excreted through urine. The Compendium of Pharmaceuticals and Specialties states that after doses of about 2.5 to 5.0 mg, about half of a dose is excreted in urine. Folic acid supplementation may rarely cause allergic reactions including erythema, pruritus and/or urticaria. Doses of folic acid up to 5.0 mg have not been known to have adverse effects on pregnant women or their fetus.	**Recommendation** For clients with a BMI ≥ 30 kg/m^2, midwives should discuss the benefits of a diet high in nutrient-dense, folate-containing foods before and during pregnancy to reduce the risk of NTDs. For clients who cannot maintain a high-folate diet, midwives may also discuss the risks and benefits of administering a supplement with 0.4 mg to 5 mg of folic acid. [II-2-B] [new 2019]	• This statement has been changed from a summary statement to a recommendation due to the availability of new research on the topic. • The original summary statement did not provide clear guidance on folic acid supplementation due to conflicting evidence at the time • New research on the benefits of folate intake and supplementation for high-BMI individuals was found, and current research consistently recommends folate supplementation for all BMI groups during pregnancy. • There was no research to determine a specific dosage of folic acid for high-BMI clients, and thus a dosage range was included in this recommendation.

Table 1: Updated 2019 Recommendations, Summary Statements and Explanation of Changes*		
Original Recommendation or Summary Statement from 2010	Updated Recommendation or Summary Statement [new 2019]	Explanation of Change(s)
Midwifery-Specific Considerations: High BMI		
Recommendation All women with BMI ≥ 30 should have an informed choice discussion of increased risks during labour. The following should be included as part of the informed choice discussion: • Increased risk of fetal macrosomia [II-2-B] • Increased risk of postpartum hemorrhage[II-2-B] • Increased difficulty of ausculating the fetal heart [II-2-B] and the potential need for internal fetal heart rate monitoring [III-C] • Increased risk of having a missed abnormality on ultrasound (NTD) [II-2-B] • Increased risk of stillbirth [II-2-B] Midwives should support the choice of birthplace for women with BMI > 30 once increased risks have been discussed.	**Recommendation** BMI ≥ 30 kg/m^2 alone is not an indicator for hospital birth. Midwives should support choice of birthplace for clients with a BMI ≥ 30 kg/m^2. [II-2-B] [new 2019]	• This recommendation was separated into two new summary statements and a new recommendation. *[See the section Antenatal and Intrapartum Complications: High BMI in this table for one summary statement; and the section Fetal and Neonatal Complications: High BMI of this table for the other new summary statement.]* • New evidence on choice of birthplace for high-BMI pregnancies was found and included in the updated CPG; therefore, a new recommendation and classification were created based on this evidence. • *[See the section Antenatal and Intrapartum Complication: High BMI in this table for an explanation of all other changes to the original recommendation.]*

*Section headings referred to in this table reflect those used in the updated 2019 version of this CPG.

Table 2: Medical conditions indicating increased risk suggesting planned birth at an obstetric unit	
Disease area	Medical condition
Cardiovascular	• Confirmed cardiac disease • Hypertensive disorders
Respiratory	• Asthma requiring an increase in treatment or hospital treatment • Cystic fibrosis
Haematological	• Haemoglobinopathies – sickle-cell disease, beta-thalassaemia major • History of thromboembolic disorders • Immune thrombocytopenia purpura or other platelet disorder or platelet count below 100×10^9/litre • Von Willebrand's disease • Bleeding disorder in the woman or unborn baby • Atypical antibodies which carry a risk of haemolytic disease of the newborn
Endocrine	• Hyperthyroidism • Diabetes
Infective	• Risk factors associated with group B streptococcus whereby antibiotics in labour would be recommended • Hepatitis B/C with abnormal liver function tests • Carrier of/infected with HIV Toxoplasmosis – women receiving treatment • Current active infection of chicken pox/rubella/genital herpes in the woman or baby • Tuberculosis under treatment
Immune	• Systemic lupus erythematosus • Scleroderma
Renal	• Abnormal renal function • Renal disease requiring supervision by a renal specialist
Neurological	• Epilepsy • Myasthenia gravis • Previous cerebrovascular accident
Gastrointestinal	• Liver disease associated with current abnormal liver function tests
Psychiatric	• Psychiatric disorder requiring current inpatient care

Source: (105)

Table 3: Other factors indicating increased risk suggesting planned birth at an obstetric unit

Factor	Additional information
Previous complications	• Unexplained stillbirth/neonatal death, or previous death related to intrapartum difficulty • Previous baby with neonatal encephalopathy • Preeclampsia requiring preterm birth • Placental abruption with adverse outcome • Eclampsia • Uterine rupture • Primary postpartum haemorrhage requiring additional treatment or blood transfusion • Retained placenta requiring manual removal in theatre • Caesarean section • Shoulder dystocia
Current pregnancy	• Multiple birth • Placenta praevia • Preeclampsia or pregnancy-induced hypertension • Preterm labour or preterm prelabour rupture of membranes • Placental abruption • Anaemia – haemoglobin less than 85 g/litre at onset of labour • Confirmed intrauterine death • Induction of labour • Substance misuse • Alcohol dependency requiring assessment or treatment • Onset of gestational diabetes • Malpresentation – breech or transverse lie • BMI at booking of greater than 35 kg/m^2 • Recurrent antepartum haemorrhage • Small for gestational age in this pregnancy (less than fifth centile or reduced growth velocity on ultrasound) • Abnormal fetal heart rate/doppler studies • Ultrasound diagnosis of oligo-/polyhydramnios
Previous gynaecological history	• Myomectomy • Hysterotomy

Source: (105)