Obstetrician and Gynecologist's Perspectives on the Definition and Management of Obesity in
Pregnancy

by

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ABSTRACT

Introduction: Obesity is a complex disease affecting increasing numbers of reproductive aged

women. Despite ongoing research efforts, many knowledge gaps remain when caring for

women with obesity in pregnancy. Currently, there is no clearly defined, comprehensive

standard of care for pregnant women with obesity. Consequently, obstetricians and gynecologists

(OBGYNs) have developed different approaches. In this study, how the management of women

with obesity differs from that of normal weight patients was explored. Another aim was to gain

a better understanding of how OBGYNs define obesity, as there is currently no consensus

definition.

Methods: A mixed methods approach was used. Qualitative concept maps were generated

through individual in-depth mapping sessions with seven OBGYNs and analyzed

thematically. Major themes informed survey development. The resultant survey was

distributed to OBs in Edmonton (n=58). Responses were entered into a Research Electronic

Data Capture Database (REDCap) and descriptive statistics performed. Finally, semi-structured

interviews with residents in obstetrics and gynecology were conducted until saturation about the

current working definition and ideal definition of obesity in pregnancy. Ethics approval was

obtained.

Results/Conclusions: Obstetrics and Gynecology residents and staff physicians relied on varying

subjective measures to classify patients as having obesity or not. They defined and appreciated

risk secondary to obesity at different Body Mass Index (BMI) points. While they found it useful,

BMI was not routinely used and on its own was felt to be insufficient to define obesity. Clinicians prefer a definition of obesity that incorporates a more comprehensive picture of patient health and wellbeing. This could include medical comorbidities and specific barriers to care that may provide insight into weight distribution. Establishing a consensus definition and classification of obesity in pregnancy would allow for more standardized care plans to be developed.

Limited professional education opportunities, lack of specific counseling tools, time constraints, and negative bias toward women with obesity in pregnancy all act as barriers to providing evidence-based care to women with obesity. Education strategies addressing these barriers will help empower obstetrical care providers to become champions of weight management in the future. Current guidelines do not address many of the areas physicians identify as challenging and important in the care of women with obesity in pregnancy. Revision of national guidelines should incorporate those areas OBGYNs deem most crucial to providing high level care.

PREFACE

This thesis is an original work by Shawna Stafford. Some of the research conducted involved collaboration. Dr. A. Demsky assisted with data collection and analysis. M. Yaskina assisted with statistical analysis. At the time of submission of this thesis, no part of this thesis has been submitted for publication. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, "MANAGING PREGNANCY AT TERM IN WOMEN WITH OBESITY: THE SCOPE OF PRACTICE IN THE ABSENCE OF A GUIDELINE", No. Pro00075676, 1/29/2018.

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LIST OF ABBREVIATIONS

OBGYN	Obstetrician and Gynecologist
BMI	Body Mass Index
WHO	World Health Organization
HTN	Hypertension
KOSC	Kings Obesity Staging Criteria
EOSS	Edmonton Obesity Staging System
IOTF	International Obesity Task Force
AUB	Abnormal Uterine Bleeding
PCOS	Polycystic Ovarian Syndrome
OCP	Oral Contraceptive Pill
IUCD	Intrauterine Contraceptive Device
ART	Assisted Reproductive Technologies
LH	Luteinizing Hormone
DM2	Diabetes Type II
CAD	Coronary Artery Disease
MetS	Metabolic Syndrome
HDP	Hypertensive Disorder of Pregnancy
GDM	Gestational Diabetes Mellitus
GWG	Gestational Weight Gain
VTE	Venous Thromboembolism
RR	Relative Risk
REDCap	Research Electronic Data Capture Database
SD	Standard Deviation
CI	Confidence Interval
IUGR	Intrauterine Growth Restriction
EFW	Estimated Fetal Weight
LGA	Large for Gestational Age
NST	Non-Stress Test
MFM	Maternal Fetal Medicine
IUPC	Intrauterine Pressure Catheter
SOGC	Society of Obstetricians and Gynecologists of Canada
ACOG	American College of Obstetricians and Gynecologists
SFH	Symphysis Fundal Height
SDR	Socially Desirable Response Bias

1   LITERATURE REVIEW:

1.1   DEFINING OBESITY:

The World Health Organization (WHO) has defined obesity as an "abnormal or excessive fat accumulation that may impair health".[1] Traditional definitions of obesity, however, are being challenged as the prevalence of obesity continues to rise and research furthers the medical community's overall knowledge of this disease. The world is starting to recognize obesity as a chronic disease. In 2015, the Canadian Medical Association recognized obesity as a chronic disease, shortly after the American Medical Association had done the same.[2] Other organizations, including Obesity Canada and the WHO, have followed suit.

The most widely accepted anthropometric measure used to classify overweight and obesity is body mass index (BMI). BMI is a person's weight (kilograms) divided by a measure of their height (meters squared). BMI classifies individuals as underweight (BMI<18.5kg/m^2), normal weight (BMI 18.5-24.9 kg/m^2), overweight (BMI 25.0 – 29.9 kg/m^2) and obese (BMI > 30 kg/m^2) (Table 1.1). BMI is an efficient tool for clinicians to use as it is easy to calculate. Waist circumference is another commonly used measure of obesity. It is a surrogate marker for visceral fat and can provide additional insight into an individual's fat distribution. Visceral fat has been linked to the development of obesity related comorbidities including diabetes, hypertension (HTN), cardiovascular disease and mortality.[3, 4]

There are limitations to BMI and waist circumference as measures of obesity. First, both are affected by differences in normal values for patients of different ethnic backgrounds. Second, neither provide insight into a patient's current health status to determine which patients are more negatively impacted by their excess adipose tissue. For example, consider the following two patients: Patient 1 is 35 years old, has a BMI of 40 kg/m^2, is able to exercise vigorously three times per week, describes good mood and has no medical comorbidities. Patient 2 is also 35 years old, has a BMI of 35 kg/m^2, has gastroesophageal reflux disease treated with daily medication, sleep apnea and is unable to engage in strenuous exercise because of knee pain from osteoarthritis. Although the BMI of the second patient is lower, their excess weight is causing significant health

issues that are negatively affecting their quality of life. If waist circumference were substituted into these examples, the same results could occur as it is affected by similar limitations. Due to these limitations, BMI has been suggested to be used only as a screening tool to identify those at risk of having obesity and as a measure to follow patients' body changes should they engage in weight management programs. A more comprehensive definition is therefore needed to better understand a patient's health status as it pertains to any excess adipose tissue.

Newer classification systems for obesity include the Kings Obesity Staging Criteria (KOSC) and Edmonton Obesity Staging System (EOSS).[5, 6] The KOSC grades twelve aspects of obesity related morbidity in alphabetical order and was designed to help minimize inter-observer variability. The areas graded include: airways, BMI, cardiovascular disease, diabetes, economic complications, functional limitations, gonadal and reproductive axis, perceived health status/stages of change, body image/eating behaviour, and other medical complications.[5] The EOSS also seeks to assess a patient's global wellbeing and classifies patients into one of five stages. Stage 0 is the least severe stage, representing the obese phenotype with no comorbidities while Stage 4 represents a patient with obesity and with obesity related end-stage disease.[6] Patients with a classification of Stage 2 – 3 have increased all-cause mortality when compared to those of lower stages.[7] By incorporating the sequelae of obesity into the staging criteria, a more accurate prediction of mortality than BMI alone is achieved. Both of these systems allow for a more wholistic assessment of a patient's health than metrics alone.

1.2   THE EPIDEMIOLOGY OF OBESITY IN CANADA:

By the 21st century, obesity had reached epidemic status, surpassing infectious diseases and undernutrition as the most common cause of poor health.[8] With rising rates of obesity around the globe, obesity has now achieved pandemic status.[9] While developed nations used to be most affected, developing countries are now also facing this health crisis and its' numerous sequelae.[8]

According to Statistics Canada, a minority (42.1%) of Canadian women have a normal weight (BMI $18.5 - 24.9$ kg/m^2).[10] A staggering 54.4% of Canadian women are now classified as having overweight or obesity (Figure 1.1). Children are less affected by

obesity with 18.2% of female children having overweight and 9.5% having obesity (Figure 1.1).

The increasing prevalence of obesity places a growing financial burden on the Canadian health care system. The costs attributable to overweight and obesity in Canada, including obesity related comorbidities, was $6.0 billion in 2006.[11] This reflects 4.1% of that year's total health expenditures.[11] Given that the prevalence of obesity continues to rise, and that there are increasingly recognized obesity related comorbidities, costs related to this chronic disease will continue to escalate.

1.3   THE LIFELONG EFFECTS OF OBESITY ON WOMEN'S HEALTH:

Obesity affects women of all ages. As prevalence increases across all age groups, the effects of excess adiposity on women throughout their lives are more readily observed. Understanding the ramifications of obesity will help inform effective treatment strategies and, most importantly, prevention efforts.

1.3.1   CHILDHOOD OBESITY:

While the prevalence of obesity is rising in children, there is no evidence based, clinically relevant, widely accepted definition of obesity in children. In children, age, sex, puberty, and ethnicity can all contribute to differences in classification. For example, children experience dramatic changes to weight and height as they grow making common measures such as BMI unreliable. Two common criteria used to understand obesity prevalence include the WHO classification of obesity and that of the International Obesity Task Force (IOTF). When compared, the former lacks specificity while the latter lacks sensitivity.[12] Regardless of which definition is used, both systems are thought to underestimate the actual prevalence of obesity in children, particularly in female children.[13] Without proper tools and definitions to recognize obesity, opportunities for intervention could be missed.

Obesity affects nearly every organ system in a child's body. Serious health concerns, previously only seen in adults, are increasingly common in children. These include, but are not limited to, HTN, dyslipidemia, Type II diabetes and fatty liver disease. Obesity accelerates the atherosclerotic process.[14] As those affected by

childhood obesity reach adulthood, their risk for cardiovascular disease and metabolic syndrome is augmented.[15] Obstructive sleep apnea and reactive airway disease are more prevalent in children with obesity as well[16], making efforts to incorporate exercise into a healthy lifestyle more difficult.

Despite excessive calorie intake, children with obesity often suffer nutrient deficiencies. In particular, excess adiposity is associated with low levels of vitamin D and twice the risk of developing iron deficiency when compared to children of normal weight.[17, 18]

Girls face some unique issues secondary to obesity. As the female child with overweight or obesity approaches puberty, she is at increased risk of early or precocious puberty.[19] In girls, pubertal milestones include the onset of breast development (thelarche), first appearance of pubic hair (pubarche) and first menses (menarche). Having central rather than peripheral fat distribution augments the risk of early thelarche and pubarche.[20] While the first menstrual cycle typically happens between 12 and 15 years of age, girls with overweight or obesity are at increased risk of early menarche.[21] Significantly, precocious puberty is associated with developing depression, female reproductive tract cancers and metabolic syndrome later in life.[22]

1.3.2 <u>THE EFFECTS OF OBESITY ON WOMEN:</u>

1.3.2A *Abnormal Uterine Bleeding (AUB) and Infertility*

Elevated BMI is increasingly associated with abnormal uterine bleeding. A normal menstrual cycle typically lasts between 21 and 35 days and ends with an average of 5-7 days of menstrual bleeding. Abnormal uterine bleeding can incorporate any change from a normal menstrual cycle, including changes in cycle length, days of menstrual bleeding and amount of blood lost.[23] Both women with overweight (BMI 25.0 - 29.9 kg/m^2) and obesity (BMI $\geq$ 30 kg/m^2) have a significantly higher risk of developing menstrual irregularities with increasing BMI.[24] A comprehensive understanding of what types of menstrual irregularities are most commonly encountered in this population is currently understudied. One study looking at menstrual irregularities in adolescent females with obesity seeking bariatric surgery found that only 4% of participants reported no menstrual irregularities.[11] Of the remaining 96%, 28% reported menorrhagia, 32%

had oligomenorrhea, 40% suffered dysmenorrhea and 36% had polycystic ovarian syndrome (PCOS).[25]   Although this was a small study involving 25 participants, there is a striking difference in prevalence between women with obesity (36%) and those of reproductive age in the general population (5-10%).[26]

AUB can negatively impact a woman's quality of life. It is associated with increased absence from work, reduced ability to partake in daily activities and leisure activities, fatigue, pain and increased financial burden for those who suffer heavy bleeding because of the high cost of feminine hygiene products.[27] Additionally, AUB is associated with the development of metabolic disorders including triglyceridemia, dyslipidemia and diabetes mellitus.[28] With rising prevalence of obesity, subsequent increases in incidence of AUB and both the direct and indirect sequelae are forecast to rise.

1.3.2B   *Contraception*

There is mixed data about the effectiveness of contraception in women who have overweight or obesity. Obesity can negatively impact the effectiveness of contraception by affecting renal, hepatic and endocrine functions that then alter metabolism and therefore drug clearance. Oral contraceptive pills (OCPs) are among the most common forms of birth control used in North America and prescribed in a "one dose fits all" fashion. Women with obesity who take OCPs have lower concentrations of the drug in plasma and it takes longer after initiation of an OCP for it to reach steady state in the blood when compared to normal weight women.[29, 30] Some studies, despite demonstrating reduced plasma levels of the studied contraceptive, demonstrate equal ovulatory suppression in women with elevated BMIs.[30] Further research is needed to understand how effective the OCP is in women with obesity.

Another common form of contraception in the industrialized world is an intrauterine contraceptive device (IUCD). For progesterone containing IUCDs, lower levonorgestrel concentrations are found in women with obesity compared to women of normal weight.[31, 32] The clinical significance of lower plasma levels remains unclear. In one study looking at patient satisfaction with Mirena IUCD use, fewer women with

higher BMIs achieved amenorrhea, and those that did took years, rather than a few months, compared to normal weight women.[33]

Obesity is associated with numerous comorbidities that can further limit contraception options for these women. For example, women with obesity are at increased risk of venous thromboembolism.[34] The extent to which estrogen containing contraception can augment this risk in women with obesity is yet to be understood. The clinical risk for emergency contraception has been more clearly elucidated. Women with obesity treated with ulipristal acetate and levonorgestrel emergency contraception are at three times greater risk of pregnancy compared with women of normal weight who receive the same treatment.[35, 36]

Special consideration should be given to women who are undergoing bariatric surgery during their reproductive years. Weight loss of even 5% can restore ovulatory function in those suffering from anovulatory infertility.[37] Women who have received bariatric surgery are at an almost two-fold increased risk of unplanned pregnancy compared to baseline population risk.[25]

1.3.2C   *Fertility*

Obesity is strongly associated with lower fertility rates. Regardless of how a woman with obesity tries to conceive, with spontaneously or with assisted reproductive technologies (ART), lower fertility rates ensue.[38, 39] Regardless of whether a patient is having regular menstrual cycles or having less regular, potentially anovulatory cycles, her time to pregnancy will be prolonged if she is overweight or obese.[40, 41] For those with anovulation and menstrual irregularities, a large percentage are affected by PCOS. Roughly 5-10% of women of reproductive age are diagnosed with PCOS, making it one of the most common endocrinopathies in this group of women.[26] While PCOS can affect women of normal weight, it's prevalence and severity correlate positively with increases in weight. Further, weight loss has been shown to improve fertility rates and some metabolic features related to PCOS. PCOS is diagnosed utilizing the Rotterdam Criteria that includes 1) oligo or anovulation, 2) clinical manifestation of hyperandrogenism and 3) polycystic ovaries seen on ultrasound.[42] With increasing rates of obesity, subsequent rises in the levels of PCOS and subfertility are increasing. While helping a woman with

PCOS achieve a pregnancy can be relatively simple, it is not without consequence. ART carry with them risks, both to mother and fetus, that are augmented further by obesity.

Although the number of women with obesity seeking ART is increasing, achieving pregnancies in this population is challenging. In one study, a 30% reduction in probability to conception was seen for each 0.1 unit increase in wait-hip ratio for women receiving artificial insemination.[43] Women with obesity often require higher doses of medications and have lower rates of fertilization, embryo transfer, implantation and pregnancy than those of normal weight.[44] Because weight loss of, or exceeding, 10% of a patients' body weight significantly increases the likelihood of achieving pregnancy, weight loss should be the primary medical intervention prior to trying ART.[45] Weight loss achieved using any method, be it lifestyle interventions in the form of diet and exercise, medical interventions or surgical interventions, improves pregnancy rates and live births in women with excess adiposity.[46] Weight loss is associated with improvement in menstrual regularity and increased natural conception. Therefore, the need for ART is reduced in patients who achieve weight loss.[46]

Numerous theories are emerging to explain the observed sub-fertility in women with obesity. A woman's physiology changes significantly when she has excess adipose tissue. Adipose tissue leads to increasing peripheral aromatization of androgens to estrogens. Thus, the greater the accumulation of adipose tissue, the greater the amount of free estradiol in a woman's system. Obesity also induces a relative state of insulin resistance. As a result, levels of sex hormone-binding globulin decrease, which in turn also increases levels of estradiol.[47] With higher levels of estradiol, typical regulation of a woman's luteinizing hormone (LH) surge can be impaired. Lower LH pulse amplitudes and decreased average amounts of LH released are observed in women with obesity.[48] This overall altered endocrine milieu can significantly impair folliculogenesis.

Obesity is also considered a pro-inflammatory state. Inflammatory markers including TNF-alpha, IL-6, CRP are all found at elevated levels in women with obesity.[49] This inflammatory environment can negatively impact reproductive cycles and fertility rates by not only affecting oocyte quality, but also the ability of the uterus to implant a pregnancy. To better understand the uterine receptivity in women with obesity, Bellver et al. (2013)[50] examined the reproductive outcomes of more than 9000 cycles of invitro

fertilization with ova from normal weight donors. They demonstrated that in recipients whose BMI was greater than 30kg/m^2, implantation, clinical pregnancy and live birth rates were all significantly reduced.[50]

1.3.2D   *Female Cancers*

Overweight and obesity are recognized as a significant risk factor for the development of at least 13 different types of malignancies.[51] It is estimated that in the U.S., over 50% of newly diagnosed female cancers are related to overweight or obesity.[51] These cancers include breast, endometrial, cervical and potentially ovarian cancers. Obesity is also predictive of a worse course and higher mortality rates once diagnosed with breast and cervical cancer.[52] While current understanding of exactly how obesity impacts prognosis for women diagnosed with ovarian and endometrial cancer, it is clear that these women face higher rates of intra-operative and post-operative complications when managed surgically.[53, 54]

1.3.2E *Diabetes Type II, Coronary Artery Disease and Metabolic Syndrome in Women with Obesity*

Obesity is an independent risk factor for the development of diabetes mellitus Type 2 (DM2) and coronary artery disease (CAD) in women. The risk of both increases as weight increases, with a central weight distribution being most harmful. Being overweight or obese is likely the single most important predictor of the development of DM2 with a meta-analysis demonstrating a pooled relative risk (RR) of developing DM2 of 12.41 for those with obesity.[55] In a large cohort study, women with severe obesity (BMI>35kg/m^2) had an odds ratio (OR) of 2.7 for CAD and 5.4 for HTN.[56] For both DM2 and CAD, weight loss can improve or lead to resolution of HTN, DM2, hyperlipidemia, and improvement in fasting glucose and insulin levels.[57, 58]

Metabolic syndrome (MetS) is a newly recognized syndrome that is defined as a combination of central obesity, elevated triglycerides, low high density lipoprotein cholesterol, hypertension and impaired glucose tolerance.[59] While many of these conditions are historically associated with advancing age, women of reproductive age are now increasingly at risk given the dramatic increase in overweight and obesity. Current

guidelines do not recommend routine screening for triglyceride or cholesterol abnormalities in reproductive aged women with obesity.[60] Women with PCOS are known to be at significantly increased risk of MetS.[61] An astute clinician may therefore investigate a patient with PCOS for the metabolic disturbances associated with MetS. Women with obesity without PCOS, however, are likely under-investigated for this syndrome. Opportunities to recognize and intervene early are therefore likely being missed. Furthermore, the current definitions of MetS do not address in any way diseases that occur during pregnancy, such as hypertensive disorders of pregnancy (HDPs) or gestational diabetes (GDM). Greater understanding of MetS in young women is needed.

1.4   OBESITY IN PREGNANCY:

1.4.1   DEFINING OBESITY IN PREGNANCY:

Obesity is most commonly defined and classified using BMI. Although other methods of measuring adiposity such as waist circumference are also in use, BMI is the most widely accepted and used. Canadian guidelines for defining obesity are based on the WHO classification[8] and are illustrated in Table 1.1. While these definitions are widely accepted and used in the general population, defining obesity in pregnancy can be more problematic. Various definitions are currently in use. For example, the WHO classification can be used with either pre-pregnancy weights or pre-natal weights to calculate BMI. As women are expected to gain weight as the fetal unit increases in size and maternal physiologic changes occur that can increase body weight, BMI can fail to delineate normal versus abnormal changes in maternal body habitus. Other definitions include the use of a finite weight cut-off, for example >90kgs at any point in pregnancy, or use of ideal body weight calculations.[62] Lack of a consensus definition makes interpreting and extrapolating from research studies difficult.

1.4.2   GESTATIONAL WEIGHT GAIN:

Canadian gestational weight gain (GWG) guidelines are based on pre-pregnancy BMI (Table 1.4.2).[62] In a large Canadian study of 1541 participants, 49.4% of women

gained above what was recommended based on their pre-pregnancy BMI. Again, those who were classified as having overweight or obesity were at highest risk of gaining weight above the guidelines.[63] Nearly half of pregnant American women (47.5%) gain excessive gestational weight.[64] For women who already have overweight or obesity, their risk of excessive gestational weight gain is further increased to 61.6% and 55.8%, respectively.[64] Excessive GWG is an increasingly recognized risk factor for GDM and HDP. Furthermore, excessive GWG is associated with increased risk of developing life-long overweight or obesity.[65]

1.4.3   EFFECTS OF OBESITY IN THE ANTENATAL PERIOD:

When a woman with obesity achieves a pregnancy, she and her fetus face numerous increased risks. In the following section, these risks will be explored.

1.4.3A   *Spontaneous Abortion, Birth Differences and Still Birth*

If women with obesity are able to achieve a pregnancy, they are at higher risk of spontaneous abortion. For women with obesity conceiving spontaneously, the RR of early and recurrent losses are 1.25 and 4, respectively.[66] Even if ART is used to help achieve pregnancy, women have increasing risk of miscarriage with increasing BMI.[67] Should pregnancy progress, maternal obesity is associated with an increased risk of various congenital malformations. These include cardiac, ventral wall and cleft palate defects. Alarmingly, women with obesity have approximately a two-fold increase in risk of fetal neural tube defects as well and do not seem to gain protection from folic acid supplementation compared to women of normal weight.[68, 69] In addition to being at increased risk of birth differences, suboptimal visualization of fetal structures during routine anatomic ultrasound scans is common in women with obesity which can make detection of these differences challenging. In one recent prospective study, women with obesity had an 11.3% increased chance of having an incomplete scan compared to women of normal weight. Their scans also took longer and had lower anatomical quality scores.[70] Having suboptimal scans means an increased number of repeat scans are required to achieve adequate visualization of the fetus. The possibility of adding

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additional scans, such as an endo-vaginal fetal assessment for women with obesity, at 15+1 weeks gestation has been shown, in conjunction with routine transabdominal scanning at 18-22 weeks, to allow for a greater proportion of quality scans with higher sonographer satisfaction.[71]

As BMI increases, so too does the risk of having a stillbirth. Having severe obesity (BMI>40kg/m^2) carries approximately a three-fold increase in odds of antepartum stillbirth compared to women of normal weight.[72] Weight loss pre-pregnancy and careful weight management in the antepartum period is therefore crucial to help women avoid such losses.

1.4.3B *Gestational Diabetes Mellitus*

GDM is a common metabolic complication where variable degrees of insulin resistance and abnormal blood glucose levels are recognized for the first time in pregnancy. Approximately 2-5% of Canadian pregnancies in women of a healthy BMI are affected by GDM.[73] The incidence roughly triples to an estimated 12% in women with obesity.[74] Even in women who are classified as overweight with BMI≥25kg/m^2, a significantly increased risk is observed with a RR of 3.8 of developing GDM.[74] Some studies demonstrate a gradient affect where the odds of developing GDM increases with increasing BMI which means a woman with a BMI of 40kg/m^2 would have a greater risk than the same type of person with a BMI of 25kg/m^2 or 30kg/m^2.[75] The exact mechanism of how this occurs is not completely understood but it is currently postulated that adipose tissue produces adipocytokines, many of which are pro-inflammatory, that create a state of low-grade inflammation. This in turn impairs insulin signalling and induces insulin resistance.[76, 77]

The consequences of GDM are seen in both mother and fetus. GDM is associated with increases in maternal morbidity. Adverse maternal conditions including pre-eclampsia, polyhydramnios, birth trauma and operative delivery are all associated with GDM.[78] Further, mothers with obesity and a history of GDM have twice the prevalence of developing DM2 than women of normal weight.[79] With a risk of development of DM2 of 10% per year[80], the number of women facing this becomes staggering. In utero and

immediately post-partum, the fetus faces increased risk of macrosomia, hypoglycaemia and hyperbilirubinemia. Increasingly, however, long term sequelae of being born to mothers with GDM are being realized including children having significantly higher rates of obesity, impaired fine and gross motor functions and higher rates of inattention and hyperactivity.[81, 82] These intergenerational effects highlight the need for preventative strategies to minimize risk of mothers developing GDM and obesity.

1.4.3C *Hypertensive disorders of pregnancy*

HDPs are the second most common cause of maternal mortality in industrialized countries.[83] HDPs include gestational HTN and preeclampsia. Gestational HTN is defined as HTN that is new in onset at 20 weeks of gestation or beyond. Preeclampsia, traditionally, is new onset HTN with associated proteinuria although more contemporary definitions include an array of clinical and laboratory findings in conjunction with HTN.[84] While HDPs complicate 0.7 – 4.7% of pregnancies in normal weight women, up to 13.5% of pregnancies in women with obesity are complicated with HDPs. With each 5-7kg/m^2 increase in pre-pregnancy BMI, the risk of gestational HTN increases and preeclampsia doubles.[85] Additionally, women with obesity have a higher incidence of chronic hypertension at conception.[86]

The link between obesity and HDPs is not completely understood. However, the development of HDPs is thought to be multifactorial and numerous mechanisms likely contribute to this pathology. One proposed mechanism is faulty placentation secondary to the pro-inflammatory state obesity induces. An increase in pro-inflammatory cytokines in women with obesity could result in a reduction in angiogenic growth factors and impairment of placental development.[87] Further, women with obesity are known to be at increased risk of hyperlipidemia, hyperinsulinemia, clotting and endothelial dysfunction. These conditions could predispose the placenta to ischemia or infarction.[87] It is important to note that not all women with obesity develop HDPs. This is likely because of the multifactorial nature of the disease predilection. A genetic component is likely, given that daughters to mothers who had eclampsia or preeclampsia are at significantly higher risk of developing HDPs than the baseline population risk.[88, 89] The modern-day obesogenic environment may also contribute. Excessive caloric intake

contributes to obesity and diets laden with simple carbohydrates are associated with higher levels of endothelial dysfunction that could affect the maternal fetal unit. Similarly, women are leading increasingly sedentary lives putting them at further risk of developing obesity. Exercise has been shown to be protective, lowering the odds of developing HDPs.[90]

1.4.3D *Venous Thromboembolism*

Venous thromboembolism (VTE) is another major cause of maternal morbidity and mortality in developed countries. Although VTE is a relatively rare event occurring in an estimated 2-10 per 10,000 pregnancies, it remains among the leading causes of direct maternal death during the end of pregnancy and up to six weeks post-partum.[91] Given its increase in prevalence, overweight and obesity are likely the most common risk factors for VTE in pregnant women. Compared to non-obese women, women with obesity have an adjusted odds ratio of 5.3 (95% CI 2.1-13.5) of developing a VTE.[92] To understand this augmented risk, Virchow's triad is considered: venous stasis, a hypercoagulable state and vascular damage. During normal pregnancy, pelvic vessels are compressed by the growing weight of the gravid uterus contributing to venous stasis. For women with obesity, the restriction of venous flow is worsened by the excess adipose tissue in the abdomen.[93] Additionally, women with obesity are often less active further causing venous stasis. Pregnancy also induces an increase in coagulation factors and decrease in anticoagulants.[94] This is further exacerbated by obesity which may promote a hypercoagulable state by inducing a hyperinsulinemia or pro-inflammatory state.[93] Finally, in terms of vascular damage, while a certain amount of trauma is inherent in any delivery, women with obesity are at increased risk of birth trauma, post-partum hemorrhage and caesarean section, increasing their risk for VTE above that of their normal weight counterparts.[95, 96]

1.4.4 EFFECTS OF OBESITY IN THE INTRAPARTUM PERIOD:

1.4.4A *Induction of Labor*

Obesity is associated with significantly reduced odds of achieving a vaginal delivery.[97] Should induction be attempted, women with obesity fail twice as often as

women of normal weight.[97] Rates of induction failure tend to mirror increases in obesity with rates rising from 20.2% to 24.4% to 29.0% for BMIs (kg/m^2) of 30-34.9, 35-35.9, and greater than 35.9, respectively.[98] Norman et al. (2012) showed that should labor be achieved, patients with a BMI of greater than $30kg/m^2$ take longer to reach 6 cm of cervical dilatation than those with a normal BMI (20-25 kg/m^2).[99] This prolongation is exaggerated in those with even higher BMIs regardless of whether labor is spontaneous or induced[99] and may be due to decreased contractility of the myometrium of obese patients secondary to increased levels of cholesterol and leptin.[100] Oxytocin usage is greater in women with obesity and may help counteract decreased myometrial contractility.[96] If care providers do not adjust their expectations to a slower and longer labor in women with obesity, a diagnosis of labor dystocia may be inappropriately applied resulting in declaration of failed induction and need for subsequent delivery by caesarean section. Caesarean delivery, whether elective or after a failed induction, carries higher maternal morbidity than a vaginal delivery.[101]

1.4.4B   *Obesity Affects Mode of Delivery and Rate of Intervention*

When a gravid patient reaches term, delivery is achieved either vaginally or through caesarean section (Figure 1.4). Ideally, spontaneous labour and a subsequent spontaneous vaginal delivery ensues as this is the safest mode of delivery for both maternal and fetal patients.[102] If labour does not occur spontaneously, or should a timed delivery be required for other indications (e.g. GDM), an induction of labour can be offered to the patient. Occasionally, intervention in the form of an operative vaginal delivery is required (i.e. vacuum or forceps assisted delivery). With increased intervention, be it in the form of induction or occasionally operative vaginal delivery, risk of emergent caesarean delivery rises. While vaginal delivery is the safest mode of delivery, the emergent caesarean section is at the opposite end of the risk spectrum. Most caesarean sections are not emergent, but rather planned or 'elective'. An elective caesarean is a pre-arranged part of the care plan agreed upon by both patient and obstetrical care provider for various obstetrical indications. Both emergent and elective caesarean section are major abdominal surgeries that carry risk but risk is augmented to both maternal and fetal patient in an emergent scenario.[103, 104] The

emergency caesarean section is considered the highest risk delivery therefore a scenario obstetrical care providers aim to prevent when possible.[103]

The risk inherent in any delivery plan is augmented by maternal obesity. Obesity increases a patients' propensity for intervention and lowers the probability of achieving a spontaneous vaginal delivery.[97, 105–107] Statistically, higher numbers of pregnant patients with obesity receive inductions of labor and caesarean sections, be it elective or emergent.[105] The risk of intervention increases with increases in BMI (Figure 1.4). In a 2014 study of a Canadian population, 39.3% of women with overweight and 49% of women with obesity had their labor induced compared to only 28.8% of normal weight women.[97] Among the women with induced labor, obesity was a statistically significant risk factor for delivery by caesarean section.[97] The incidence of increased induction in women with obesity over those with a normal-weight was replicated in another study where 40.0% of overweight and 47.0% of obese women had their labor induced compared to only 31.0% of normal weight women.[106] Further, the relative risk (RR) for delivering by caesarean section, either elective or emergent, increases with increasing BMI.[95] While overweight women have RR of 1.3 and 1.6 for elective and emergent caesarean section, obesity increases this to 1.9 and 2.2, respectively (compared to normal weight women).[95]

Obesity has been found to be an independent risk factor for caesarean section.[95] Poobalan (2009) showed that compared to women of normal weight, the odds ratio (95% confidence interval) of caesarean section increased from 1.53 (1.48, 1.58) in overweight women to 2.26 (2.04, 2.51) and 3.38 (2.49, 4.57) in obese and morbidly obese women, respectively. Excess fatty tissue serves to complicate caesarean sections increasing the mean operative time, rates of vertical skin and uterine incisions, rates of wound infection, hematoma and seroma formation, and increased risk of requiring readmission to hospital.[108, 109] Regardless of mode of delivery, women with obesity face increased risk of post-partum haemorrhage and on average have longer hospital stays.[96] Increasing intervention translates into higher rates of morbidity for this growing patient population.

Social factors can contribute to the higher rates of induction of labor and caesarean section in pregnant women with obesity. A study published in 2015 showed that obstetrical care providers uniformly identified patients as 'high risk' if they had obesity even if they possessed no other medical comorbidities.[110] In the interviews

conducted, it became evident that maternal BMI significantly influenced clinical management. Paradoxically, for some care providers this meant more aggressively pursuing a vaginal delivery to avoid the risks incumbent in a surgical delivery whereas for others, it meant a lower threshold for Caesarean section.[110] A physician's perception of risk may also be influenced by stories they have heard from fellow care providers and from fear of litigation should patients feel dissatisfied or perceive an aspect of their care was under-investigated or lacking in some way. OBGYNs are one of the top ten most sued specialties in medicine.[111] Nearly all (92%) of OBGYNs surveyed by Jena et al. (2011) admitted to ordering tests to reassure themselves or their patients of their decisions, not because the investigations were medically necessary.[111] Fear of being accused of malpractice may drive a physician to practice 'defensive medicine'. When the top nine reasons for legal action against an OBGYN were examined, six of the nine were related to failure to perform a caesarean section or failure to do so in a timely manner further fueling the obstetrical maxim that 'the only caesarean section you will regret is the one you do not perform.'[111] The extent to which defensive medicine contributes to increased interventions in women with obesity is unknown.

1.4.5 <u>EFFECTS OF OBESITY IN THE POST-PARTUM PERIOD:</u>

The post-partum period is also complicated for women with obesity. In the immediate post-partum period, women with obesity are more likely to suffer from depression. The more severe their obesity, the more likely this complication is to occur.[112] Post-partum depression can have negative impacts on bonding between mother and child, on the neurodevelopment of the child, and if left unattended can result in maternal mortalities.

After delivery maternal obesity is associated with increased incidence of lactation dysfunction. Women with obesity are 3.65 times less likely to establish successful breastfeeding[113] and more likely to discontinue breastfeeding prior to three months post-partum than women of normal weight.[114] Breast feeding can help women lose weight gained during a pregnancy and is associated with less post-partum weight retention.[115] Approximately 13-20% of women have significant (>5kg) weight retention 12 months post-partum.[65] This may be significant because excess gestational weight gain and the

inability to lose weight post-partum are predictors of developing obesity as well as its associated metabolic comorbidities in midlife.[116, 117]

1.4.6   OBESITY AFFECTS MEDICAL CARE:

While there is significant progress being made in understanding the physiologic changes of patients with obesity, very little research has looked at the significant sequelae of weight stigma. Weight stigma is an increasingly recognized social phenomenon and one of the more prominent, yet understated, forms of discrimination in society today. Weight stigma is the exhibition of prejudiced attitudes and discriminatory actions towards a person based on weight. Its consequences have the power to permeate all facets of an individual's wellbeing. Weight stigma has the potential to impact, in a negative way, a person's physical, mental, and emotional wellbeing. Unfortunately, weight stigma is a common obstacle in the healthcare system.[118, 119] Some healthcare providers have been shown to respond differently to patients based on their size. On an individual level, physicians report increasing frustration and reduced job satisfaction when treating patients with obesity.[119] Patients with obesity are less likely to attend routine health visits, such as cancer screening, that is performed via Pap testing and mammography.[120, 121] This decreases timely intervention and treatment of cancers. Through discrimination, patients' social worlds can diminish resulting in higher rates of depression. Discrimination can impact the workplace and lead to difficulties finding and maintaining employment and therefore achieving financial stability. These effects are true for any patient with obesity, but how this affects a woman during pregnancy is of particular concern.

There is a growing body of work showcasing the experiences of pregnant patients with obesity receiving maternity care. These patients describe numerous frustrations when interacting with members of the obstetrical care team. First, patients with obesity describe getting minimal and conflicting information about how weight affects their pregnancy.[122, 123] They describe that despite being weighed regularly, care providers often avoid discussions of weight.[123] Should the topic be broached, it is done in a way that leaves patients feeling both stigmatized and confused, as conflicting advice, often based on stereotypes, is provided.[124] Only with improved accuracy and consistency of

information can women know how much weight to gain in pregnancy, and how to make healthy lifestyle decisions to achieve those goals.

Another area of concern for women with obesity is how abruptly care ends in the post-partum period. In Canada, women are typically scheduled a single post-partum visit. Patients report having minimal guidance provided at these appointments about post-partum weight loss, despite this being a topic of great importance to them.[123, 124] Alternate post-partum schedules and models of care need to be considered for women with excessive gestational weight gain, overweight or obesity to ensure patients understand the importance of post-partum weight loss, and have resources to help them return to their pre-pregnancy weight. As more is learned about what information patients need and value during pregnancy and the post-partum period, care models can be adjusted to ensure patient-centered care, free from negative stigma, is truly being delivered.

1.5   SUMMARY

Obesity is a complex chronic disease that negatively affects the health of women throughout their lives. Research is continually providing further insight into the scope of effects obesity has on women's health. However, this research is slow to reach obstetricians, who are responsible for caring for women with obesity in pregnancy. Currently, the SOGC has a single guideline addressing the care of women with obesity in pregnancy. It has a total of nine recommendations, most of which recommend counseling patients about achieving a healthy weight and the consequences of excess adipose tissue to both mother and fetus. The current guideline, despite being reaffirmed in 2018, fails to address numerous existing questions about the care of women with obesity in pregnancy. Obstetricians rely on guidelines for efficient knowledge translation. Without a guideline outlining a consensus approach for the management of women with obesity in pregnancy, obstetricians are forced to develop their own unique strategies. I therefore wanted to investigate the different approaches OBGYNs in Edmonton and surrounding areas have when caring for pregnant patients with obesity, and why they have developed their unique approach.

1.6 **RESEARCH OBJECTIVES:**

Obesity is a chronic disease of growing prevalence that OBGYNs face every day. The purpose of this study is to achieve a better understanding of how obesity impacts an OBGYN's approach to the management of women in pregnancy and whether these differences can explain why pregnant women with obesity experience higher rates of intervention at term. Using an exploratory sequential mixed methods approach, I aim to:

1. explore different approaches to the care of the pregnant patient with obesity,
2. gain a better understanding of when, how and why OBGYNs perceive patients with obesity as high-risk patients,
3. explore different working definitions of obesity in pregnancy, and
4. understand what would be included in a clinically relevant, useful definition of obesity in pregnancy.

The first phase of the study used qualitative exploration to understand how obesity impacts an OBGYN's management of women in pregnancy. Data will be collected from OBGYNs, analyzed and used to develop a quantitative survey that can be administered to a larger sample of OBGYNs. Quantitative data will provide insight into practice patterns for managing women with obesity in Edmonton and surrounding areas. The reason for using this mixed method approach is to allow development of a survey that is culturally relevant to the population of OBGYNs being studied, highlighting issues and questions they deem important, and to allow, through comparison of both quantitative and qualitative findings, greater insight than would be obtained using either quantitative or qualitative data collection alone.

The second phase of this study is a qualitative inquiry, using semi-structured interviews, to understand current definitions of obesity in pregnancy being used in clinical practice. What resident OBGYN physicians would include in an ideal definition of obesity will be explored as well.

Table 1.1. WHO classification of adults based on body mass index (BMI).

Classification	BMI (kg/m^2)
Underweight	<18.5
Normal Range	18.5-24.9
Overweight	≥25.0
Obese Class I	30.0 – 34.9
Obese Class II	35.0 – 39.9
Obese Class III	≥40.0

Table 1.2. Suggested gestational weight gain (kg) by weight classification (BMI).

Classification	BMI (kg/m^2)	Suggested Weight Gain (kg)
Underweight	<18.5	12.5-18
Normal Weight	18.5-24.9	11.5-16
Overweight	≥25.0	7-11.5
Obese Class I	30.0 – 34.9	7
Obese Class II	35.0 – 39.9	7
Obese Class III	≥40.0	7
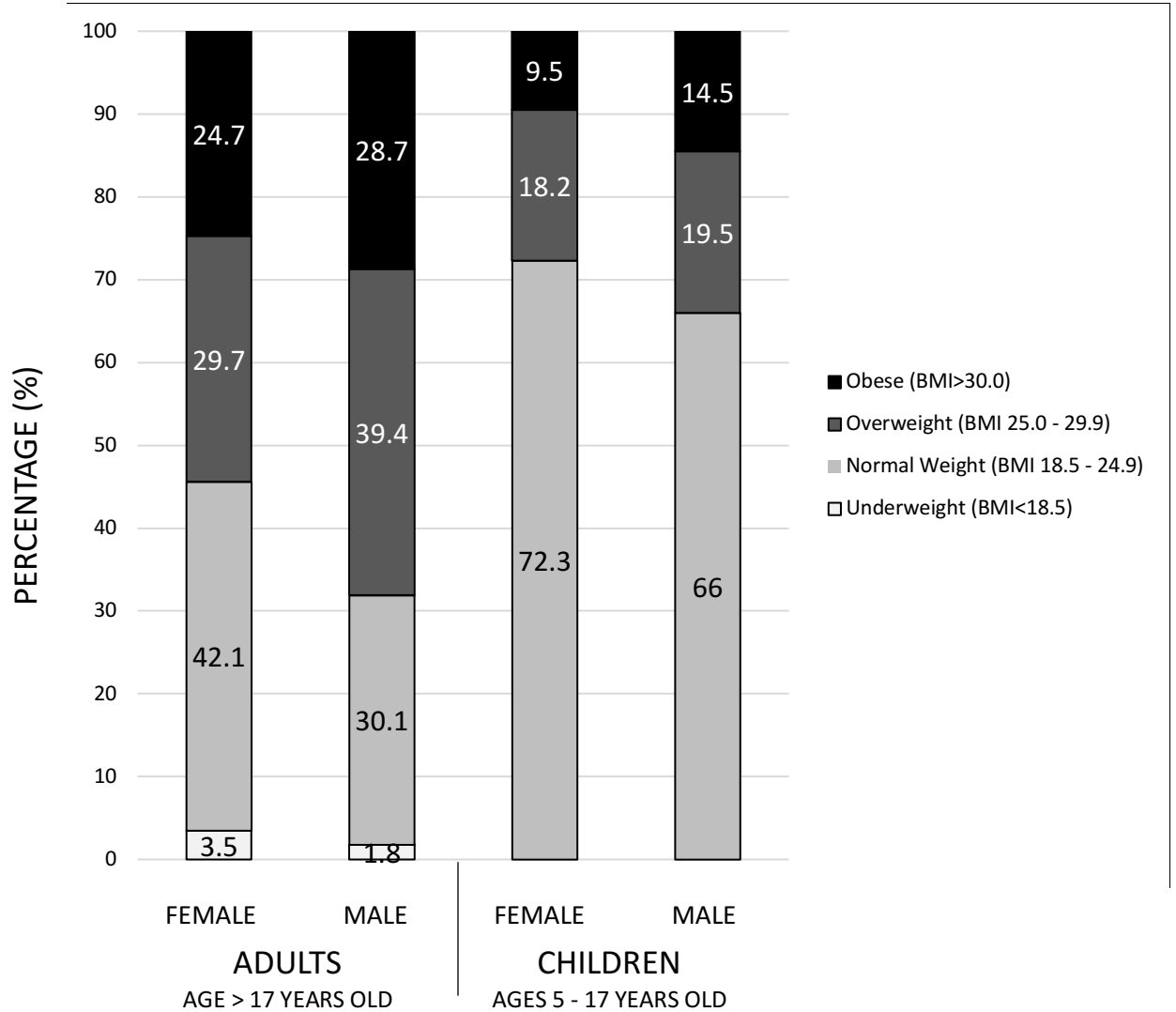
Figure 1.1. The percentage of Canadian female and male adults and children who are underweight, normal, overweight or obese (Data from the 2015 Canadian Community Health Survey – Nutrition).[10, 125]
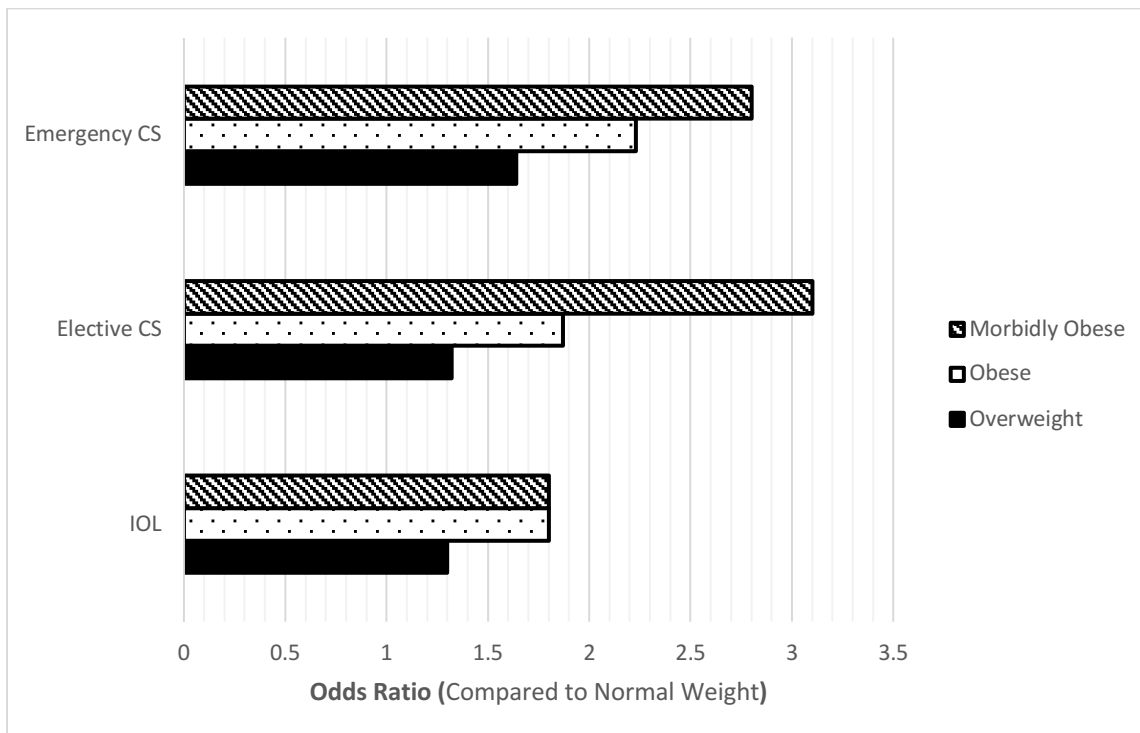
Figure 1.2. Odds ratios of having an emergency caesarean section, elective caesarean section or induction of labour in patients who are overweight (BMI 25-29.9 kg/m^2), obese (BMI 30-34.9 kg/m^2) or morbidly obese (BMI>34.9 kg/m^2) compared to patients of normal weight. Data from Vinturache et al., (2014)[97] and Poobalan et al., (2009).[95]

2   MANAGING WOMEN WITH OBESITY IN PREGNANCY: THE SCOPE OF PRACTICE IN THE ABSENCE OF A GUIDELINE

2.1   INTRODUCTION:

Obesity is a chronic and complex disease that has reached pandemic status. Globally, obesity has surpassed infectious diseases and undernutrition as the most common cause of poor health.[126] Since the 1980s, global rates of overweight and obesity have increased from 29.8% to an estimated 38.0% in women of all ages.[127] In Canada, a minority, 42.1%, of Canadian women are considered to have a normal weight.[10] A staggering 54.4% of Canadian women are now overweight or obese (Figure 1.1). In young women of reproductive age, 46.0% are affected by overweight (24%) or obesity (22%).[128] The increasing prevalence of obesity places a growing financial burden on the Canadian health care system, with costs estimated at $6.0 billion in 2006.[11] Given that both the prevalence and severity of obesity continue to rise, costs related to this chronic disease will continue to escalate.

An increasing number of pregnancies are affected by maternal obesity. Obesity affects pregnancy in all phases. First, obesity is associated with sub-fertility. Regardless of whether spontaneous conception or ART are used, lower fertility rates ensue for women with obesity.[38, 39] When a woman with obesity achieves pregnancy, she is at higher risk of spontaneous abortion[66, 67] and having a fetus affected by congenital malformations.[129] Ultrasound technologies, typically used to surveil a pregnancy are less effective in women with abdominal adiposity.[70] This is concerning given that the risk of stillbirth is higher for women with obesity.[72] Delivery planning is complex for patients with obesity as care providers are faced with a troubling paradox: that pregnant women with obesity are less likely to achieve a low risk vaginal delivery yet offering alternatives in the form of operative or cesarean deliveries are associated with significantly higher rates of maternal morbidity.[75, 130, 131] Of all these risks perhaps the most concerning is that obesity in pregnancy is associated with increased risk of childhood obesity thereby propagating this disease to the next generation.[132, 133]

Since the beginning of the 21st century recognition of obesity as a serious health issue and research investigating it has dramatically increased. According to a MedLine search, the number of published articles about obesity in pregnancy has risen from only 160 prior to the year 2000 to over 5000 in the last ten years. Despite the increased research velocity, many knowledge gaps remain when caring for women with obesity in pregnancy. There remains no clearly defined, comprehensive standard of care for pregnant women with obesity. Consequently, obstetrical care providers have developed different approaches to their management. In this study, a mixed-methods design was used to explore how OBGYNs approach the management of women with obesity in pregnancy and how their practice approaches differ from that of normal weight gravidas. By examining current practice patterns, commonalities and discrepancies will be highlighted providing insights into the areas that are most contentious and challenging for front line health care providers. This information can be used to create targeted tools to transfer the most up to date research findings to OBGYNs, who are caring for these patients every day.

2.2   METHODS:

2.2.1   EXPLORATORY SEQUENTIAL MIXED-METHODS DESIGN:

An exploratory sequential mixed methods design was selected.[134] This method is done in four phases:1) collection and analysis of qualitative data, 2)developing a quantitative tool or instrument based on qualitative findings 3) implementation of the quantitative tool and 4) interpretation of quantitative and qualitative results.[134] Conducting qualitative inquiry with concept mapping first, allowed the identification of important issues to OBGYNs in this geographic area and generation of a quantitative survey that could be administered to a larger sample (Figure. The use of mixed methods allows for the strengths of both qualitative and quantitative methodologies to be incorporated into a single study. While qualitative research allows for a deeper exploration of how and why obesity impacts the management of women in pregnancy, a quantitative exploration allows for broader assessment, albeit more superficial, of practice patterns that exist amongst OBGYNs in this geographic area.

2.2.2   CONCEPT MAPPING:

  The participants of this study included seven (n=7) OBGYNs in Edmonton, Alberta who were certified by the Royal College of Physicians and Surgeons of Canada and who had an active obstetrical practice. To help establish rigour, physicians with diverse perspectives were recruited (Table 2.1). Two physicians from each of the four major obstetrical centers in Edmonton and surrounding area were recruited via e-mail. A mix of male and female participants with varying training backgrounds and at various points in their careers were approached. A total of eight physicians were invited to participate and saturation was reached after concept mapping with seven of them. Basic demographics and written, informed consent were collected from each participant. Ethics approval was received from the University of Alberta Human Research Ethics Board.

  Concept mapping is a concise knowledge representation tool that shows ideas in hierarchical maps.[135, 136] The process begins with a focus question, in this case: "How does obesity affect your management of women at term gestation?" The question is generated to "make explicit the questions or problems" of the topic of interest.[137] It is designed to highlight different opinions, thought processes and provide insight into the conceptual understanding of the participant.[136, 137] The same two study investigators conducted all of the concept mapping sessions where one was the facilitator and one was the mapper. While the facilitator was responsible for providing the focus question and asking probing questions to encourage brainstorming, the mapper actively mapped key concepts to create a live concept map. Cmap Tools software (v6.03.01) was used to generate maps. Concepts were then rated and sorted by the participant and assembled in a hierarchical fashion with the most general and important concepts at the top of a map and most specific at the bottom. Propositions were used to highlight relationships between concepts.[137] Maps were reviewed and finalized by the two investigators independently after the session was complete and e-mailed to participants to ensure they agreed with the structure of the final map. No compensation was provided for participation.

  Maps were analyzed thematically. Thematic analysis is the process of identifying patterns or themes within qualitative data that are important and interesting and provide

insight into the topic of interest. A six-step framework provided by Braun and Clarke (2006)[138] was used to analyse the maps. In brief, maps were read and re-read to achieve data familiarization. Data was then organized systematically into meaningful groups or codes. A theoretical, open coding method was used meaning that data that was relevant to the focus question was used to develop and modify codes as analysis progressed. Codes were assembled into themes. Latent themes or themes that '…start[s] to identify or examine the underlying ideas, assumptions, and conceptualisations…' were made.[138] Themes were reviewed by the co-investigator and committee members to enhance rigour. Any disagreements about themes were discussed and content adjusted until themes were all agreed upon, increasing dependability of our analysis. Reflexive journaling was done by both concept mappers at the conclusion of each concept mapping session.

2.2.3 <u>SURVEY</u>:

A survey was designed based on the major themes from concept mapping to further explore differences in practice patterns for the management of women with obesity at term (Appendix A). Because qualitative results highlighted different definitions and conceptualizations of the definition or threshold for considering a woman as having obesity, the primary outcome of the survey was designed to be the BMI threshold at which a patient would become high risk from an obstetrical perspective. The survey was designed to have a temporal, clinical flow starting with questions about the pre-natal period moving on to questions about induction of labor, intrapartum management, caesarean section and postpartum management. The survey concluded with a section on knowledge translation and physician demographics. Completion time was an anticipated barrier to achieving a high participation rate and therefore a survey with a completion time of less than ten minutes was created. Selecting a dichotomous, categorical scale using 'yes' and 'no' options facilitated efficient responses. On the physical survey, the 'yes' response was followed by 'no' for all questions as positive to negative ordering allows respondents to provide quicker responses.[139] Further, 'yes' and 'no' responses reduce the effect of acquiescence bias compared to using 'agree' and 'disagree' statements. A third option of neutrality, for example, "don't know" or "no opinion" was not included in this survey. Because OBGYNs encounter a high volume of

patients with obesity it is unlikely they do not have formed opinions about their management and providing this third option could lead to incomplete, less informative survey data.[140]

The survey generated was distributed to OBGYNs in Edmonton, Alberta and surrounding area after being piloted on a small group (n=5) of OBGYN resident physicians to ensure coherence. This area encompassed one tertiary referral hospital and three community hospitals all of which provided care for women with obesity in pregnancy and were willing to participate in the proposed research. Return of the survey implied consent. Response rates and results were recorded and entered into a REDCap database. Statistical analysis was performed. Continuous data was summarized by the mean and the two-sided 95% confidence interval (CI) of the mean (normal approximation), standard deviation (SD), median, first and third quartiles, minimum and maximum. Categorical data is presented by absolute and relative frequencies (n and %).

At the conclusion of data collection, quantitative data was compared to that collected in the qualitative phase. Final conclusions will be drawn based on integration of both data types.[134]

2.3   RESULTS – CONCEPT MAPPING:

2.3.1   OBESITY AFFECTS AN OBGYNs MANAGEMENT OF WOMEN DEPENDING ON HOW THEY DEFINE OBESITY:

In response to the focus question, participants unanimously voiced that obesity would indeed alter their management of patients at term. How participants defined obesity, however, differed.   While some participants used quantitative evaluation of body size, including pre-pregnancy weight or BMI calculated at pre-natal visits, others preferred a "general impression" or "gestalt" of a patient based on appearance and weight distribution including the size of the abdominal pannus. For those using quantitative assessment, there was variance in the specific BMI associated with a change in management. For example, while some described using different management strategies for patients with a BMI$\geq$35kg/m^2, others had higher thresholds of BMIs of 40, 50 or 60

kg/m^2. Quantitative assessment of patient size was described as objective which is important as "elevated BMI [can be] difficult to recognize visually" especially since its prevalence has increased to the point where obesity has "become the norm".   Without objective measures OBGYNs worried that excess weight could be missed as a risk factor for both maternal and fetal complications during prenatal care.

OBGYN's expectations for gestational weight management was variable. Weight is measured at each pre-natal visit. While some participants had strict goals for patients, for example, 0.4 – 0.6 pounds per week, others had less specific goals and aimed more generally for a "weight neutral" pregnancy. Care providers demonstrated frustration at helping patients achieve these goals as patients have "often already exceeded" weight gain recommendations by their first appointment. When possible, however, they used various tools, including referrals to dietitians, to help patients gain weight appropriately. Some participants conveyed that greater success for weight loss could be had in the post-partum period and so deferred their efforts until after their patients delivered. At this time, referrals to weight loss specialists could be made. Regardless of what advice was given or when, OBGYNs felt they spent more time counselling their patients with obesity about weight and weight related health issues compared to patients of normal weight.

2.3.2   COMMUNICATION WITH PATIENTS SHOULD BE DIRECT AND HONEST:

When discussing a patient's weight and associated risks, OBGYNs emphasized the importance of "tactful", "honest", "direct" and "frank" communication. They recognized that "patients want to be informed" about risks related to obesity or excessive gestational weight gain "even if awkward" to discuss. As a therapeutic alliance builds between a patient and an OBGYN over the course of prenatal care, barriers to achieving a healthy weight can be identified.   OBGYNs describe being motivated to find solutions to these barriers, be it financial or cultural, to help patients achieve a healthy weight.

In the current system, a patient's OBGYN is often not present at the time of delivery. The delivering OBGYN has a short time to form a relationship with a labouring patient. By having "frank" and "direct" conversations in pre-natal appointments, patients are prepared and informed should their weight be discussed in a medical capacity during

the acute phase of labour and delivery by an OBGYN who is newly involved in their care. Without this preparation, patients may become "defensive", "angry" or "hostile" when discussing weight related issues. They may perceive they are being stigmatized because of their size. OBGYNs must "be aware of [their] bias" and sensitive to the patient experience as provider bias may cause a "negative patient response", making further discussions uncomfortable for both the health care provider and the patient. OBGYNs felt that having these discussions and documenting them clearly in the health record not only helped communication but had the potential to also "mitigate medicolegal risks".

2.3.3 UNDERSTANDING FETAL WELLBEING IS MORE CHALLENGING IN PATIENTS WITH OBESITY:

OBGYNs use various methods to monitor the health of a pregnancy. In patients with obesity, unique challenges in monitoring fetal wellbeing during the pregnancy exist. OBGYNs must then deviate from the typical pre-natal protocols for fetal surveillance, both during the prenatal and intrapartum periods, to adequately understand the health of a fetus.

2.3.3A *Prenatal Monitoring*

Monitoring of fetal wellbeing in the prenatal period involves regular assessment of fetal growth. Fetal size is usually understood using maternal symphysis-fundal height (SFH) measurement. In patients with obesity, OBGYNs find this method is "unreliable" because abdominal adipose tissue can affect the accuracy and precision of measurements. This is particularly concerning as these patients are at "higher risk of large for gestational age (LGA)" and "intrauterine growth restriction (IUGR)". Without SFH for fetal growth assessment health care providers "cannot learn about the fetus" without extra ultrasound assessments that can provide information about estimated fetal weight (EFW). Ultrasound assessments near term can also determine fetal lie which is useful given that the effectiveness of traditional palpation with Leopold maneuvers is also compromised

by abdominal adipose tissue. Extra ultrasounds also serve to "reassure" OBGYNs and patients given the "increased risk of stillbirth" that patients with obesity face.

While all participating OBGYNs highlighted their preference for more ultrasounds, the number and schedule of scans varied. For example, some expressed the need for serial ultrasound assessments to assess EFW at 28, 32 and 36 weeks of gestation. Others preferred a single scan at 34 to 38 weeks. In addition to ultrasound, some OBGYNs also use non-stress tests (NSTs) to monitor for fetal wellbeing in patients with BMI>50kg/m^2.

OBGYNs tend to refer patients with obesity to maternal fetal medicine (MFM) specialists more often than normal-weight patients. Referrals were made because OBGYNs described getting scans that were "unreliable" or "incomplete" at community sites. Criteria for referral varied amongst health care providers. Some practitioners refer if early pregnancy ultrasounds are limited or unsuccessful due to weight while others had specific BMI cut-offs. These cut-offs varied from BMIs of 40 to 50 kg/m^2. OBGYNs rely on MFM to provide "high quality", reliable scans that will reduce the chances of their patients having "undiagnosed [fetal] anomalies" that could be missed at community radiology sites that see a lower volume of obstetrics patients. Given the increasing prevalence of obesity, OBGYNs recognize that if they begin referring all patients with elevated maternal BMI the capacity of the MFM clinic could be rapidly exceeded.

Despite relying on ultrasound to assess fetal growth and wellbeing, OBGYNs highlighted the limitation of this imaging modality. They describe assessment of EFW, regardless of whether it is measured in the community or at an MFM site, as an "inaccurate test". They justify its use because there is "no better tool" currently available. Because of this inaccuracy, different thresholds for changing management were described. For instance, some practitioners require two independent ultrasounds with EFW >95 percentile to truly believe a fetus is LGA. Others have found that fetuses measured at the 95 percentile were usually of normal size and would only change management if there was a documented size of "greater than the 97 – 100 percentile".

2.3.3B *Intrapartum Monitoring:*

OBGYNs find intrapartum monitoring to be "more complicated" and "more difficult". Despite it being harder, they prefer "more monitoring" and "closer monitoring" for patients with obesity in the form of "continuous fetal heart rate monitoring". To achieve this, fetal scalp electrodes are used more often to reliably monitor fetal heart rate. One participant described that while intermittent auscultation could theoretically be done for women with obesity, because it would be so much "more labour intensive" for staff, it would likely not be feasible given resource limitations in hospitals.

2.3.4 OBESITY IMPACTS INDUCTIONS OF LABOUR:

2.3.4A *OBGYNs recommend induction of labour for large for gestational age but not maternal obesity*

OBGYNs do not typically recommend induction of labour based on maternal obesity alone. While they use routine maternal or fetal indications to guide induction practices, most also consider LGA an indication for induction. Should an induction be offered, most would begin induction at 39 weeks gestational age. This practice was called into question by one physician who queried whether induction "should be offered at 37 weeks if macrosomia [is] suspected" as the fetus would potentially be too large for a successful vaginal delivery by 39 weeks.

2.3.4B *Method of induction differs for patients with obesity*

Providers had varying preferences for method of induction. Most stressed that inductions in patients with obesity are more difficult, complicated and have a lower success rate. While some would use the "same method of induction" as for a normal-weight patient, others "use more Foley catheters" and "consider mechanical induction sooner" even though they are "difficult to place" and "take longer". Some use a combination method by starting with a prostaglandin and switching to mechanical induction once the cervix is dilated enough to accommodate the Foley catheter. Those that use prostaglandins primarily noted that a higher number of prostaglandin E_2 inserts

(i.e. Cervidil) were typically required in women with obesity to ripen the cervix. Regardless of the method selected, practitioners prefer booking inductions for patients with obesity during weekday, daytime hours as there is "better access to resources" should a complication occur.

2.3.5   PATIENTS WITH OBESITY LABOUR DIFFERENTLY:

When managing labour OBGYNs expect "abnormal labour patterns" from their patients with obesity. Patients with obesity have "abnormal muscle physiology" and therefore have a "poor response to Syntocinon". Because of this the need for more augmentation of labour using "more [and] higher doses of oxytocin" was emphasized. Understanding whether augmentation is generating strong contractions is achieved traditionally by palpation of the uterus abdominally. With an increase in abdominal adipose tissue this method becomes ineffective for assessing uterine contractions in women with obesity. OBGYNs therefore use more intra-uterine pressure catheters (IUPCs) to guide augmentation and optimization of labour in patients with obesity. Despite their attempts to optimize labour, health care providers expect and allow longer labours in this patient population. While OBGYNs try to optimize labour, their management decisions revolve around trying to minimize the risk of emergency situations that would necessitate emergency caesarean section.

2.3.6   OBESITY CAUSES OBGYNs TO ALTER THEIR APPROACH TO CAESAREAN DELIVERY:

Obesity impacts an OBGYN's approach to caesarean delivery. This was an overarching and prevalent theme with rich content on all concept maps. As such, OBGYN's discussion of caesarean section was divided into subthemes, as below.

2.3.6A *Obesity is not considered an indication for elective caesarean section:*

OBGYNs did not offer elective caesarean sections to patients because of maternal obesity. Interestingly, some participants commented that "many colleagues would". Elective caesarean sections were reportedly reserved for patients who had specific recommendations for caesarean delivery from MFM, or those who had obesity plus "LGA and a very unfavourable cervix".

2.3.6B *Complications from caesarean sections in patients with obesity are "expected"*

OBGYNs described caesarean section for patients with obesity as "dangerous" and that complications are "expected". They noticed that patients with high pre-pregnancy BMI and central obesity were subject to higher rates of complications including longer operative times, wound infection, anaesthetic complications, pneumonia and longer hospital stays. Complications could extend to personal injury of health care workers in the form of back injury from transferring and positioning patients with obesity during surgery or even vaginal delivery. Participants commented that the responsibility or blame for complications lies not only with the OBGYN but with the patient as well. Medicolegal risks were described as "prevalent" in obstetrics and gynecology although participants did not feel heightened vulnerability to legal action from their patients with obesity.

2.3.6C *OBGYNs have an altered threshold for caesarean delivery in patients with obesity*

While some OBGYNs will offer a caesarean section more readily to patients with obesity, others cite a higher threshold. Numerous factors affect the decision to proceed with surgery. For example, the relative disparity of resources at night relative to day was described as an important factor. Resources like a skilled surgical assist are more readily available during the day and may incentivize getting patients with obesity delivered during daytime hours. In addition to resource availability, OBGYNs cited patient risk factors related to obesity as often lowering their threshold for caesarean section. For example, slow progress of labour in a patient with obesity who is at high risk of

cephalopelvic disproportion would more likely be managed with a caesarean delivery. Some practitioners do not offer forceps or vacuum deliveries for patients with obesity given the elevated risk of shoulder dystocia. Without this option for delivery they are more likely to resort directly to caesarean section. Finally, "guilt about handing over" patients with obesity to the next physician on call sometimes lowered threshold for delivery and pushed providers to deliver patients prior to shift change. OBGYNs with an elevated threshold reported tolerating "longer labour", ignoring guilt at handover, in order to "avoid caesarean section" and the inherent increased surgical risks for patients with obesity.

2.3.6D *The technical approach to a caesarean section differs for women with obesity*

OBGYNs approach caesarean sections in women with obesity with caution. They anticipate "increased complexity" and recognize surgery will require "more resources". More nursing staff, skilled surgical assists and proper bariatric equipment are all cited as important. Pre-operative anaesthesia consults are often sought for patients with a BMI$\geq$45 kg/m^2. As they move into the operating theatre, the patient is positioned. This often includes retracting the patient's abdominal pannus using tape or an additional surgical assist. Antibiotic prophylaxis is often given in higher doses than that given to normal weight patients. One physician uses antimicrobial gauze (i.e.Kerlix^{TM}) packed around the anticipated incision site in addition to antibiotic prophylaxis in an attempt to reduce risk of infectious complications.

As surgery begins, OBGYNs unanimously prefer a transverse skin incision, described as a "high Pfannenstiel" incision as this incision offers "better healing". Participants explicitly stated they would "…not make the incision under the pannus" as an incision insulated by an overhanging pannus is more prone to infection. To maintain retraction during surgery, a mechanical ring, such as the Alexis O-Ring, "reliably works". At the conclusion of surgery, some OBGYNs prefer closing with staples, while others prefer sutures. Those who preferred staples report liking them because they are stronger and interrupted thereby allowing for better drainage of the wound than a running subcuticular skin stitch. Further, staples require manual removal, typically done by home care nursing. One participant used staples as this guaranteed a health professional would

be inspecting the incision within the first post-operative week increasing the chance of complications being recognized early. OBGYNs also varied in their preference of wound dressing. While some prefer a prophylactic negative pressure dressing, others like a normal bandage. OBGYNs commented that their patients with obesity often have longer time to ambulation and prolonged lengths of stay in hospital post-operatively.

2.3.7   EDUCATION AND KNOWLEDGE TRANSLATION IS BOTH "INADEQUATE" AND "CONFLICTING":

The OBGYNs conveyed that they felt they had "inadequate education" or "minimal" education about managing women with obesity at term and that this lack of knowledge could lead to mismanagement and complications. Further, management of patients with obesity is made more difficult because of the lack of current, easy to access information about this subject area. OBGYNs felt that their management could be ameliorated by more formal education and improved availability of guidelines. Some physicians reflected on the current utility of the Society of Obstetricians and Gynecologists of Canada (SOGC) guideline, describing it as "not helpful", "not applicable to real life" or that it "[does] not address pertinent topics". Physicians described that a guideline would help establish a standard of care for the management of women with obesity at term. They requested that a guideline include such topics as how to perform risk stratification, decide on timing of delivery and specifics about how to best manage and monitor patients during the intra-partum period. Some specific topics included how much fetal surveillance is required, what the ideal pre-natal ultrasound schedule should be, whether NSTs should be part of prenatal surveillance at term, whether more prenatal appointments are needed and whether different bloodwork is needed to provide optimized care to patients with obesity. In addition to benefiting care providers, having concise, evidence-based information for patients with obesity may help them become more informed as well.

2.4   RESULTS - SURVEY:

2.4.1   DEMOGRAPHICS AND PRACTICE CHARACTERISTICS:

Of 58 physicians who were sent the survey, 54 responded yielding a 93.1%
response rate. Of responding physicians, 68.5% were female and 31.5% were male
(Table 2.2). The physicians have spent varying amounts of time in practice. All
participate in active obstetrical practices with the majority attending to between 100 and
500 deliveries annually. The majority (92.3%) of physicians surveyed work with a
significant number of patients with obesity. While approximately one third (29.63%) of
physicians estimate that 51-75% of their obstetrics patients had obesity, the majority
estimate that somewhere between 25-50% of obstetrics patients they serve have obesity
(Table 2.2).

2.4.2   OBGYN's PERCEPTION OF RISK BASED ON BMI:

OBGYNs classify women as high-risk secondary to maternal BMI when their
BMI falls within a range of 30-50 kg/m^2 (Figure 2.1). Most respondents use a BMI of 35
or 40 kg/m^2 (37.0% or 48.2% of respondents, respectively) to classify a patient as high
risk (Figure 2.1).

2.4.3   PRE-NATAL CARE:

With regards to pre-natal care, 94.4% of physicians surveyed do not routinely
book extra time for patients with obesity (Table 2.3). Despite this, 72.2% reported that
they often need more and take more time during pre-natal visits to counsel women with
obesity. Although weight is measured at every pre-natal visit, only 42.6% of physicians
talk about weight at every visit. BMI was not calculated or recorded at the majority of
visits (Table 2.3).

While 96.3% of physicians discuss the medical ramifications of obesity in
pregnancy, 31.5% are concerned they will offend patients by discussing weight and
weight related issues. Physicians find these conversations even more difficult when a
woman has obesity (Table 2.3). Only 51.9% feel equipped and trained to counsel
pregnant women with obesity about weight and appropriate GWG. The majority of

physicians succeed at providing patients with specific, quantitative weight gain targets (83.3%) and believe their efforts and time spent counselling will help patients to achieve these targets (75.9%).

Although 74.1% provide pre-natal appointments as per the typical schedules and do not increase frequency of office visits for patients with obesity, increased ultrasound surveillance is carried out by 75.9% of physicians surveyed.

2.4.4 PHYSICIAN'S INDUCTION PRACTICES FOR WOMEN WITH OBESITY:

When investigating induction practices, 57.4% of OBGYNs felt that obesity should be an indication for induction of labour. While 38.9% report they prefer mechanical induction for women with obesity, 81.5% use the same methods of induction as they would for patients of normal weight. Most (74.1%) find that inductions of labour are less successful in women with obesity (Table 2.4).

2.4.5 PHYSICIAN'S SURGICAL PRACTICES FOR WOMEN WITH OBESITY:

When doing caesarean deliveries, OBGYNs almost unanimously expect higher rates of complications (92.6%) (Table 2.5). Despite this, 35.2% have a lower threshold and will more readily perform a caesarean section in women with obesity. The majority (94.4%) use a transverse incision rather than a midline approach. Staples and sutures were both popular for skin closure (38.9% vs. 50.0%, respectively) and wounds were preferably dressed with negative pressure wound therapy dressings (77.8%) (Table 2.5).

2.4.6 PHYSICIAN'S INTRA-PARTUM PRACTICES FOR WOMEN WITH OBESITY:

Most physicians expect longer first (79.6%) and second (72.2%) stages of labour for women with obesity. They increase their intrapartum monitoring using continuous FHR monitoring, scalp electrodes and IUPCS (53.7%, 90.7% and 61.1% respectively) compared to women of normal weight. Approximately one third (35.2%) reported they have an overall lower threshold for abandoning labour and performing a caesarean section than for their normal-weight patients (Table 4) and 18.5% offer elective cesarean to avoid labour entirely (Table 2.6).

2.4.7   PHYSICIAN'S POST-PARTUM PRACTICES FOR WOMEN WITH OBESITY:

   After delivery, physicians treat 100% of their surgical deliveries with VTE prophylaxis (Table 2.7). Just as for pre-natal care, most follow a routine post-partum care schedule offering only the single post-partum appointment. A minority focus on weight-loss counselling (37.0%) and offer referrals to weight-loss clinics or other weight-loss resources (46.3%) during the post-partum appointment (Table 2.7).

2.4.8   EDUCATION AND KNOWLEDGE TRANSLATION:

   Overall, 57.4% of OBGYNs surveyed feel up-to-date on current evidence about how best to care for their obstetrical patients with obesity (Table 2.8). The majority (69.8%) find that available resources are not easy to access or are not up-to-date. A desire for more in-depth guidelines about how to provide current, evidence-based care to this population was reflected by 90.7% of physicians and in that only 20.4% felt current North American guidelines provided by the SOGC and the American College of Obstetricians and Gynecologists (ACOG) are adequate (Table 2.8).

QUALITATIVE PHASE

QUANTITATIVE PHASE

Concept Mapping
- Sampling: heterogenous purposive
- N=7

Thematic Analysis
1. Data familiarization
2. Coding
3. Assembling of themes

Development of Survey
- Considered all themes
- 53 items

Descriptive Statistical Analysis
- N=54
- 93% response rate

Interpretation
- Explanation of quantitative and qualitative data
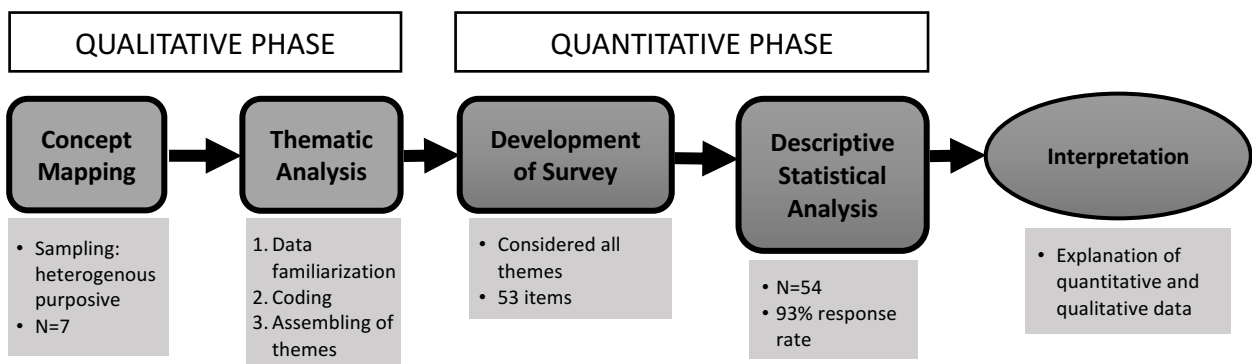
Figure 2.1. Schematic representation of the exploratory sequential mixed methods approach through qualitative, quantitative and the final interpretative phase.

Distribution of BMI at High Risk
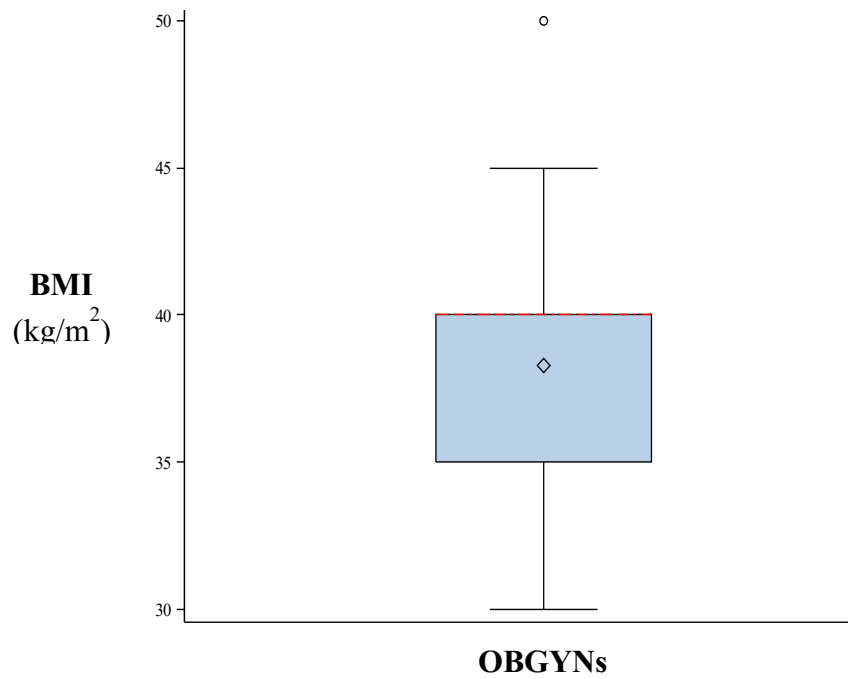
Figure 2.2. Boxplot showing the BMI at which OBGYNs (n=54) begin to classify pregnant women with obesity as high risk (Q1=35, Q2/Median=40, Q3=40, IQR=5, μ=38.3 is denoted by ♦).

Table 2.1. OBGYN demographics - Concept Mapping (n=7)

Questions:	% (n)
Sex:	
Female	71.4% (5)
Male	28.6% (2)
Time in practice:	
<5 years	42.9% (3)
5-10 years	14.3% (1)
>10 years	42.9% (3)
Deliveries attended annually:	
0-100	14.3% (1)
101-250	14.3% (1)
251-500	71.4% (5)

Table 2.2. OBGYN demographics - Survey (n=54)

Questions:	% (n)
Type of practitioner:	
Generalist OBGYN	85.2% (46)
OBGYN + fellowship training	14.8%% (8)
Sex:	
Female	68.5% (37)
Male	31.5% (17)
Time in practice:	
<5 years	25.9% (14)
5-10 years	27.8% (15)
11-15 years	13.0% (7)
>15 years	33.3% (18)
Deliveries attended annually:	
0-100	3.7% (2)
101-250	27.8% (15)
251-500	55.6% (30)
>500	13.0% (7)
Proportion of pre-natal population served with obesity:	
<0.25	7.4% (4)
0.25-0.50	63.0% (34)
0.51-0.75	29.6% (16)
>0.75	-

Table 2.3. OBGYN's pre-natal management practices for women with obesity.

Questions:	YES %(n)	NO %(n)
I book longer appointments.	5.6% (3)	94.4% (51)
I take longer in appointments regardless of time booked.	72.2% (39)	27.8% (15)
I book extra pre-natal appointments.	25.9% (14)	74.1% (40)
I calculate and record BMI at all pre-natal visits.	11.1% (6)	88.9% (48)
I talk about patient weight at every visit.	42.6% (23)	57.4% (31)
When talking about weight and GWG with women with obesity:		
I am concerned I will offend patients.	31.5% (17)	68.5% (37)
It is more difficult to discuss with patients with obesity.	53.7% (29)	46.3% (25)
I explain why these are medically important issues in pregnancy.	96.3% (52)	3.7% (2)
I provide specific numerical weight gain targets.	83.3% (45)	16.7% (9)
I believe patients want to talk about these issues.	70.4% (38)	29.6% (16)
I believe my counselling will be effective at helping women gain appropriate amounts of weight.	75.9% (41)	24.1% (13)
I request more ultrasounds in patients with obesity.	92.6% (50)	7.4% (4)
I counsel about increased risk of complications and interventions at time of delivery secondary to obesity.	90.7% (49)	9.3% (5)
I feel well equipped and trained to counsel pregnant women about how to achieve healthy GWG.	51.9% (28)	48.2% (26)

Table 2.4. OBGYN's induction practices for women with obesity.

Questions:	YES %(n)	NO %(n)
Obesity should be an indication for induction.	57.4% (31)	42.6% (23)
I use the same induction methods as for patients of normal weight.	81.5% (44)	18.5% (10)
Inductions of labor are less successful than in patients of normal weight.	74.1% (40)	25.9% (14)
I prefer mechanical induction (ex. Foley catheter) over prostaglandins.	38.9% (21)	61.1% (33)

Table 2.5. OBGYN's surgical practices for women with obesity.

Questions:		
	YES	**NO**
	%(n)	%(n)
My surgical approach is the same as for a normal weight patient.	92.6% (50)	7.4% (4)
I expect more complications.	92.6% (50)	7.4% (4)
I have an overall lower threshold for CS for women with obesity (i.e. will do CS more readily)*	35.2% (19)	64.8% (35)

	% (n)
I prefer to close skin with:	
Staples	38.9% (21)
Sutures	50.0% (27)
Both	11.1% (6)
My preferred incision is:	
Transverse	94.4% (51)
Midline	1.9% (1)
Depends on weight distribution	3.7% (2)
My preferred dressing is:	
Routine (ex. Mepore)	1.9% (1)
Honeycomb	20.4% (11)
PICO	77.8% (42)

*CS: caesarean section

Table 2.6. OBGYN's intra-partum practices for women with obesity.

Questions:	YES %(n)	NO %(n)
I expect longer:		
First Stage of Labor	79.6% (43)	20.4% (11)
Second Stage of Labor	72.2% (39)	27.8% (15)
Third Stage of Labor	13.0% (7)	87.0% (47)
I routinely request continuous FHR monitoring.	53.7% (29)	46.3% (25)
I use more:		
Scalp electrodes	90.7% (49)	9.3% (5)
IUPCs	61.1% (33)	38.9% (21)
I often use higher doses of oxytocin to induce or augment labor.	38.9% (21)	61.1% (33)
I avoid labor by offering elective CS.	18.5% (10)	81.5% (44)

Table 2.7. OBGYN's post-partum practices for women with obesity.

Questions:	YES %(n)	NO %(n)
I expect longer hospital stays post-partum.	48.2% (26)	51.9% (28)
I provide VTE prophylaxis after:		
Vaginal delivery	40.7% (22)	59.3% (32)
Elective CS	100.0% (54)	-
Emergency CS	100.0% (54)	-
With regards to post-partum appointments:		
I see patients earlier than the usual 6-week appointment.	13.0% (7)	87.0% (47)
I see patients more frequently than a single 6-week appointment.	18.5% (10)	81.5% (44)
I specifically focus on weight loss counselling.	37.0% (20)	63.0% (34)
I routinely offer referrals to weight loss clinics or other weight loss resources.	46.3% (25)	53.7% (29)

Table 2.8. OBGYN's attitudes about knowledge and educational resources for managing women with obesity in pregnancy.

Questions:	YES %(n)	NO %(n)
Overall, I feel up to date on current evidence about managing women with obesity in my obstetrics practice.	57.4% (31)	42.6% (23)
The current obstetrical guidelines provide sufficient information to manage women with obesity in pregnancy confidently.	20.4% (11)	79.6% (43)
More in-depth guidelines addressing pre-natal, intra-partum and post-partum care would be useful to me.	90.7% (49)	9.3% (5)
I find available resources about managing women with obesity easy to access and up-to-date.	30.2% (16)	69.8% (37)

2.5   DISCUSSION:

Among participating OBGYNs, this study demonstrates that there is a variable understanding of obesity, the risk it conveys, and management strategies used for this patient population in obstetrics. OBGYNs consider patients' high-risk secondary to obesity at different BMIs. With a small proportion of physicians recognizing elevated risk when a patients BMI reaches $30 kg/m^2$ (3.7%), it is not until a BMI of $40 kg/m^2$ that the majority of physicians appreciate patients as high risk (Figure 2.1). OBGYNs and physicians in other specialties have been shown to underestimate the prevalence of obesity by failing to recognize obesity until BMIs above 30 are reached.[141, 142] This variance in recognition could be attributed to the fact that there is no consensus definition of obesity in pregnancy.[62] While physicians rely on BMI to identify obesity, there is not currently a definition that incorporates the physiologic weight changes that occur in pregnancy, nor a definition that conveys clinical maternal and fetal risks associated with excess adiposity. A persons' mass or BMI alone is likely insufficient to diagnose obesity. While those measures can be used to screen and identify patients at higher risk of this complex disease, how excess adipose tissue is negatively impacting an individual's health, should be paramount. Outside of pregnancy, there is growing pressure to refine the definition of obesity to reflect health status rather than an excessive focus on body shape or size.[143] Studies are needed to better understand how obesity, as a disease, should be defined in pregnancy.

Based on BMI, over 50% of Canadian women have an accumulation of excess adipose tissue. Being 'overfat' is becoming a norm in Canadian society. Therefore, it is increasingly difficult for clinicians to appreciate which patients may be at risk of obesity or obesity related diseases without the use of objective measures. Because only 11.1% of surveyed physicians use BMI at every visit (Table 2.3), screening for obesity and therefore a patient's transition to a higher risk category may be missed.

Current SOGC guidelines recommend that women should be counselled about weight gain, nutrition and the complications of obesity in pregnancy.[62] This is not an easy task. OBGYNs emphasized that communication about weight should be "direct" and "frank" in concept mapping sessions. However, this communication style can result in lower levels of emotional rapport building with patients.[144] Nearly 40% find talking

about weight and gestational weight gain difficult (Table 2.3). This difficulty is augmented when a patient has obesity as some physicians are concerned about offending patients, a sentiment echoed by other maternity care providers.[145] Furthermore, counselling about obesity is time consuming and physicians may prioritize other topics above weight counselling.[146] The average time spent on the first prenatal visit, when most counselling is done is 20 minutes and then seven minutes, on average, for follow-ups.[147] Given that time constraints are a significant barrier to counselling and that 94.4% of physicians do not book additional time to spend with women with obesity, an alternative prenatal care model may be helpful to allow more time for weight counselling (Table 2.3). Group pre-natal classes and the recruitment of allied health professionals to create a multidisciplinary team approach could help physicians achieve counselling goals and optimize care without placing further demands on their time. Thus far, however, although group pre-natal care may be associated with improved outcomes for low-risk pregnant women, there has been no demonstrated benefit for weight outcomes.[148, 149] That said, alternative strategies for weight counselling should be considered as pregnant women are concerned about weight and gestational weight gain, and want to talk to their health-care providers about this issue.[123]

A patient's desire to talk about weight extends into the post-partum period. Typical care pathways incorporate a single post-partum follow-up visit at six weeks post-delivery and the majority of physicians surveyed (81.5%) follow this routine for women with obesity post-partum (Table 2.7). A single appointment may not provide sufficient time to discuss post-partum weight loss, a topic patients feel should be part of standard post-partum care.[123] Stressing the importance of post-partum weight control with the goal of achieving a healthy weight is becoming increasingly important given the emerging issue of intergenerational programming: the idea that a woman's nutritional and metabolic status in pregnancy can program her child to be at increased risk of metabolic diseases later in life. There exists a positive correlation between maternal BMI and her child's adiposity, diabetes status and cardiovascular health throughout their life.[150–154] In a longitudinal study of 421 mother-daughter pairs, Kubo et al. (2014) found that girls of mothers with gestational diabetes and hyperglycemia in utero had increased risk of having overweight or obesity.[155] This risk was further augmented by maternal

overweight or obesity. With an increasing number of pregnancies affected by obesity, the establishment of an inter-generation cycle of obesity is of concern.

The SOGC currently does not recommend a higher frequency of ultrasounds for women with obesity as they are not demonstrated to improve outcomes.[62] Despite this, 92.6% of OBGYNs order more ultrasounds for women with obesity (Table 2.3). The total number and the schedule of scans, however, varies between care providers. Additional scans and NSTs, particularly in women with severe obesity, serve to reassure both provider and patient as the risk of stillbirth is elevated for these women.[86] Because a thickened abdominal wall impairs the penetration of ultrasound waves, some structures may not be well seen in women with obesity, necessitating a higher number of repeat ultrasounds to complete what would typically be done in one scanning session.[156] One study suggests that offering endo-vaginal ultrasound assessment of the fetus at 15-weeks gestation in addition to the transabdominal approach for the routine anatomic scan at 18-22 weeks provides a higher proportion of high quality scans and completed anatomic assessments than traditional ultrasound regimens.[156] After completion of the anatomic survey, OBGYNs rely on ultrasound to follow fetal growth as use of symphysis-fundal height (SFH) measurements are inaccurate in women with truncal obesity. OBGYNs highlighted the limitations of ultrasounds during concept mapping sessions, stressing that it is often an "inaccurate test" for estimating fetal weight and generally understanding fetal wellbeing but that there is currently "no better tool". Whether or not obesity impacts the accuracy of ultrasound predicted birth weight remains controversial.[157–160]

When considering induction of labour, 57.4% of OBGYNs agree that obesity alone should be an indication (Table 2.4). Although there was historic concern for induction increasing risk of caesarean delivery, new studies challenge this belief.   Some studies show induction at or after 39 weeks reduces maternal and infant morbidity and without elevating risk of caesarean delivery.[161, 162] Although it is well established that induction failure is more likely in women with obesity, there is mixed evidence on which mode of induction produces the best outcomes. Currently, the SOGC does not recommend one induction method over another and 81% of physicians use the same method of induction in women with obesity as for their normal-weight patients. There is mounting evidence that mechanical induction may be superior for these patients.

Mechanical induction produces more efficient cervical ripening compared to vaginal dinoprostone in women with obesity.[163] When misoprostol is used, women with elevated BMIs achieve active labor after induction at a lower rate than women of normal weight. These BMI dependent failure rates are not seen with mechanical induction.[164] In this study, 38.9% of OBGYNs prefer mechanical induction (Table 2.4).

During labour, clinicians differ in their management strategies significantly. Women with obesity take longer in the latent phase of labour.[165–167] Zhang and Troendle (2004)[168] demonstrated that women with overweight and obesity labour slower than women of normal weight until they reached 6cm or 7cm, respectively. It is clinically important to recognize that a prolonged first stage is expected with increasing maternal BMI so that a diagnosis of first stage arrest or labour dystocia is not prematurely given and that unnecessary caesarean sections are performed. Failure to progress is one of the leading indications for caesarean delivery and is a major factor contributing to the increase in primary caesarean sections in women with obesity.[169] Twenty percent of OBGYNs did not expect a prolonged first stage (Table 2.6).

Patterns of intrapartum monitoring also differed with a high proportion (53.7%) of OBGYNs routinely requesting continuous fetal heart rate monitoring (Table 2.6). To achieve this, higher rates of both fetal scalp electrodes and IUPCs are used. This increased propensity for closer intrapartum monitoring could reflect the OBGYN's recognition of obesity as a significant risk factor for poorer maternal and fetal outcomes and their attempts to mitigate these risks.

When it came to caesarean sections, consistent with the literature, OBGYNs expect more complications.[108, 109] Despite this, 35.2% report having an overall lower threshold for caesarean section (Table 2.6), and 18.5% would offer elective caesarean section to avoid labour (Table 2.5). This is significant, whether elective or after trialling labour, caesarean section carries higher maternal morbidity than vaginal delivery.[101]

The medical landscape changes rapidly. With advances in research and the evolving patient population, it can be challenging to stay up to date on the most current evidence. The amount of information being generated about pregnancy and obesity is increasing exponentially. Despite this growth in knowledge, there is a persistent disparity in knowledge translation. Physicians feel they have "inadequate" or "minimal education"

about this topic, and 42.6% feel they are not up to date on current evidence about this patient population (Table 2.8). Similarly, midwives feel ill-equipped to address obesity with their patients.[145] Only 20.4% of OBGYNs in this study felt the current SOGC and ACOG guidelines are sufficient, highlighting the need for improved and timely guidelines. Additionally, OBGYNs highlighted some of the challenging areas they would like a guideline to address such as the ideal pre-natal schedule, including timing and frequency of ultrasounds, patient risk stratification tools, and information regarding timing and mode of delivery. By engaging with knowledge users, such as OBGYNs in this case, the most pertinent topics can be included in the next guideline on obesity in pregnancy. This will streamline patient care and arm clinicians with the best available information for clinical decision making.

2.6   LIMITATIONS AND STRENGTHS:

A strength of this study was the high response rate for the survey/quantitative component (93.1%). Because of the high response rate, it is likely the responses gathered are indeed reflective of this group of OBGYN's attitudes, beliefs and practice patterns. Surveying other groups of OBGYNs in other areas of the country would provide a more robust understanding of practice patterns for women with obesity across Canada.

A mixed methods approach allowed for a more thorough assessment of the topic at hand. The initial concept mapping allowed for discovery of subject matter that was important and relevant to OBGYNs while the quantitative piece allowed for specific inquiry. Replication of findings in both methods used lends further credence to the reliability of this data.

A constraint that needs to be recognized within both the qualitative and quantitative methodologies is Socially Desirable Response (SDR) bias. OBGYNs are part of a distinct group of professionals that often function together as a team and they may engage in a collectivist culture: a culture that prioritizes "interdependence, belongingness, pursuing common goals with others, and maintaining harmonious relationships" [170]. As such, respondents may have "[presented] their self-reported actions in the most positive manner to maintain a favourable image"[170]. Given that both members of the concept mapping team are members of the obstetrical community

(resident physicians) and that the survey was based on self-reporting actions, respondents may have been affected by SDR bias. Although there is no published mechanism for eliminating SDR, recognition of its potential effect on the responses in this survey is crucial.

2.7   CONCLUSIONS:

OBGYNs in Edmonton, Alberta define and understand the risks associated with obesity in pregnancy from a variety of perspectives. When managing women with obesity in pregnancy, physicians employ different approaches through all phases of pregnancy. Current national guidelines do not address many of the areas physicians identify as challenges to providing care for women with obesity in pregnancy.

3 DEFINING OBESITY IN PREGNANCY: AN OBGYN RESIDENT'S PERSPECTIVE

3.1 INTRODUCTION:

Obesity is affecting an increasing number of pregnant women. Current estimates suggest that 22% of reproductive aged women in Canada have obesity.[128] Obesity increases the chance of having both maternal and fetal complications in pregnancy, with a 2019 review suggesting that adiposity is associated with 24% of all pregnancy complications.[171] Complications are numerous and include hypertensive disorders of pregnancy, gestational diabetes, large for gestational age fetuses, increased birth trauma and risk of caesarean delivery.[171, 172] Recognizing patients at risk from these potential adverse outcomes is crucial for developing weight appropriate care plans that can help minimize complications to both mother and fetus.

Results from the mixed methods study revealed that OBGYNs use different definitions for obesity in their clinical practices. While some use objective measures such as BMI, others prefer subjective criteria to classify patients with obesity. Even among those who routinely use BMI, no consensus threshold BMI was identified for when a patient should be considered at risk of poorer outcomes from obesity. For example, while some care providers classify a patient as high risk at a BMI of 30 kg/m^2, others report a higher threshold where risk does not increase until a BMI of 40 kg/m^2 or more is reached. The theory of visual normalization may explain this finding. This suggests that the rapid, widespread increase in average body size has skewed the visual perception of 'normal'.[173] As society becomes more accustomed to larger bodies, overweight and obesity are increasingly perceived as normal. In studies looking at how accurately health care providers could identify patients with overweight or obesity, health care providers were shown to systematically underestimate both the presence and severity of obesity.[174, 175] Similar studies have not been done in pregnancy. However, extrapolation of these findings is logical given that reproductive aged women are increasingly affected by excess adiposity. Obstetric care providers are likely equally affected by habituation and visual normalization as those in primary care.

If obesity is not being reliably recognized, the complications associated with this condition in pregnancy cannot be anticipated, planned for and ideally, prevented. One of the first steps to countering this effect is to establish an accepted, evidence-based definition of obesity in pregnancy. This will better allow care providers to not only recognize overweight and obesity but the risks their pregnant patients may face as a result of it. The objective of this qualitative study was to explore the current understanding of what obesity in pregnancy is, and what obstetrical care providers feel is crucial to include in a definition that would help them understand obesity related risks in pregnancy.

3.2   METHODS:

Using an exploratory qualitative methodology, interviews were conducted to learn about obstetrics and gynecology resident's perceptions and thoughts about their current understanding of the definition of obesity in pregnancy and how they understand risk associated with obesity. Semi-structured, in-depth interviews were used to explore participants experiences and perspectives about this topic, to gain an understanding of "what is important in the mind of the informant: their meanings, perspectives, and definitions; how they view, categorize and experience the world."[176, 177] An interview guide was created and employed. It was modified after each interview as an iterative approach was used. Each interview was unique, as it was influenced by participants own understanding and experiences of obesity in pregnancy. Interviews allow the exploration of the "how and why questions rather than focus on the what or cause and effect hypotheses."[177] This study was approved by the Health Research Ethics Board at the University of Alberta.

Residents currently enrolled in obstetrics and gynecology residency at the University of Alberta were eligible for participation. Participants were contacted with information about the study via email. If a response indicating a desire to participate was received, a follow-up email was sent to schedule an interview. If no response was received, a second and final email was sent to participants. Researchers engaged in no further contact about the study to ensure residents were not pressured into participation.

Thirteen interviews were conducted with obstetrics and gynecology residents in Edmonton, Alberta, between October 2018 and December 2018. Interviews were semi-

structured. A question guide, including possible probative questions, was designed and used for each interview. The guide was piloted in one interview prior to initiation of data collection. All interviews were conducted by the primary researcher and lasted 30-50 minutes. Written informed consent was obtained prior to the initiation of each interview.

Interviews were recorded and transcribed verbatim by the primary researcher. For transparency and credibility, two components of a rigorous qualitative study, transcripts were verified for accuracy by the co-investigator. Data were analyzed by the primary investigator and co-investigator thematically, using the method outlined by Braun and Clarke (2006).[138] Having a second person analyze and code enhances rigour by improving both reliability and credibility in the study design. After data familiarization, data was coded and codes then grouped into meaningful themes, where appropriate. An inductive process was used. Discrepancies were discussed and modified until resolved. Data saturation was reached for each of the themes. To further establish rigour, reflexive journaling was done at the conclusion of each interview.

3.3 RESULTS:

3.3.1 DEMOGRAPHICS:

A total of 16 residents agreed to participate but saturation was reached after 13 interviews were complete. The majority or 85% (n=11) of participants identified as female, while the remaining as male (n=2). Residents recruited were in their first three years of their residency program (Year1=5; Year2=5; Year3=3). The topics discussed with residents were consistent. Data about residents' perception about the definition of obesity and how they would ideally define obesity as well as education about obesity were organized into categories and themes.

3.3.2 RESIDENTS DEFINE OBESITY DIFFERENTLY USING PREDOMINANTLY SUBJECTIVE CRITERIA:

Residents report shifting thresholds for what they use to classify patients as having obesity. With regular patient encounters, it becomes more challenging to discern who should be classified as a person with obesity and who should not. Residents explain they

become accustomed to seeing large patients. One respondent remarked that as their career in medicine advances, their threshold for considering that a pregnant woman has obesity increases. Objective BMI cut-offs to define obesity are no longer associated with unhealthy body size. Using visual inspection and subjective measures to classify obesity might cause patients in overweight, obese and even severe obese categories to go unrecognized. Residents highlighted that the implications of under diagnosing those impacted by excess weight can lead to management plans that fail to recognize the complications these patients may face in pregnancy.

"It's funny because I think my threshold of what is obese versus not has definitely changed since coming into medicine. I don't think anything of a BMI of 30. It just seems pretty average."
-Participant R6

"I don't think I would really think twice if I saw someone whose BMI was 30. I don't think it would even be on my radar as a problem."
-Participant R9

"I would say there are lots of patients who are probably in that BMI category of 25 to 35 that don't set off your radar but that are overweight or obese and aren't getting the optimal care. And it might be because we just don't know what to do and because we just don't recognize them as obese."
-Participant R12

Residents unanimously explained that patients are routinely recognized as high risk from obesity only when patient weight reaches an 'extreme'. Participants "only ever [got] concerned with the morbidly [*sic*] obese". For example, they describe reliable handover about obesity only when the patient is "very, very, very obese", "when the patient is really on the upper end of the weight spectrum" or "when it was super obvious" visually.

Residents are aware that their recognition and classification of obesity is "not standardized". Instead, it is subjective. Many participants cite using a "general clinical

gestalt" to determine whether a patient faces additional risks from obesity. When probed about what exactly their 'gestalt' entailed, no objective measures were routinely employed. Residents were all well versed in available anthropometric classifications, such as BMI and waist circumference but instead of using these, most rely on visual inspection of a patient to make their determination of whether a pregnant woman has obesity or not. As patients are often met donning loose hospital gowns or under blankets, correctly interpreting height and weight, without objective measures, leaves significant room for error. The unreliability of subjective measures was repeatedly mentioned by participants, despite its pervasive use, and was described by one resident as "unacceptable given that [obesity] affects over 30% of our patients".

"It's subjective. There's never a BMI listed. No number. The way we define obesity
is not objective by any means. You couldn't possibly be less scientific about that."
-Participant R7

"If we're not measuring things then we are missing them."
-Participant R2

"I don't have a firm guideline…like I would say, it sounds bad but you almost sort of
see someone and just by visual inspection can tell that they're obese. You see that they
are bigger. I don't base it on any specific measurement or guideline or anything."
-Participant R12

3.3.3 BMI SHOULD BE INCORPORATED IN A DEFINITION OF OBESITY IN PREGNANCY:

Residents were asked what their ideal definition of obesity in pregnancy would include. They described that for a definition to be truly useful it had to be simple, easy to use and produce clinically relevant information about an individual woman's risks in pregnancy. All proposed definitions included an objective measure, most commonly BMI. While waist circumference was brought up it was dismissed by residents because a

growing abdomen in pregnancy would render it difficult to interpret in a meaningful way. Despite its described ease of use, most participants explained that they rarely, if ever, calculated BMI for themselves nor was it regularly recorded elsewhere on their patient's chart.

"In terms of actual definitions, for the purpose of simplicity, BMI is probably the easiest way to go. It might not be the best way to go – it's just distribution of weight over height, but I think for simplicity sake I can't think of another parameter that would be as easy to use as BMI."
-Participant R1

Residents recognize the limitations of BMI and that "obesity is more complicated than a single number". They emphasize that metrics should not be used exclusively to define obesity but should serve as a screening tool to identify those patients who may be at risk of adverse events secondary to excess weight.

"Everybody that is using BMI knows its limitations and knows it is imperfect and so I don't think it should be used as a be-all-end-all, but as one tool that can be used to screen. A tool to give you a heads up."
-Participant R4

The unique situation of pregnancy was highlighted as another challenge for using a simple metric like BMI. Residents were unsure of how to interpret BMI in gravid patients who were expected to gain weight from not only the growing fetus, placenta and amniotic fluid, and because of the myriad of maternal physiologic adaptations that occur in pregnancy. To avoid this challenge some residents routinely use a pre-pregnancy BMI to understand a patient's risks in pregnancy. They described that they felt that a patient's BMI at the onset of pregnancy was the best predictor of risks and that weight gained during pregnancy was less likely to cause adverse events. Others felt differently, that pre-pregnancy BMI on its own, without considering gestational weight gain, would not accurately convey the risks a patient would face later in pregnancy and at time of delivery.

Instead, total gestational weight gained or BMI at time of delivery would serve as better predictors of risk. Participants kept highlighting that while BMI provides basic insight into patient size, it fails to reliably predict adverse events.

"When I get a BMI from my calculator, you have to remember you are factoring a baby in there, a sack of fluid and a placenta. BMI then seems to make less sense as a good measure. We need to understand that a BMI of 40 outside of pregnancy is not equivalent to a BMI of 40 inside of pregnancy."
-Participant R9

"I don't think we have found the way to define what overweight or obese really is in a way that accurately reflects the risk factors associated with it."
-Participant R11

3.3.4 <u>AN IDEAL DEFINITION OF OBESITY IN PREGNANCY GOES BEYOND METRICS:</u>

Residents wanted information beyond BMI included in a definition of obesity in pregnancy. Weight distribution was repeatedly considered as critically important. Residents explained that central obesity is particularly problematic for the obstetric patient because it can impede in the provision of usual care and fetal surveillance. For example, abdominal adipose deposits make assessing the fetus using ultrasounds and dopplers to capture fetal heart rate more difficult and, occasionally, impossible as these technologies can only capture information up to a certain depth of tissue. Central obesity also affected residents' surgical planning. Caesarean sections were repeatedly described as being more difficult when patients have central obesity especially in planning where to make the initial incision.

"I also want to say that I want to know their body habitus – like abdominal circumference or weight distribution…that just keeps coming to my mind because of the actual care you have to provide – is it going to be harder to monitor them? Is it going to be harder to examine them? Is surgery going to be harder? That is clinically relevant information that should be in a definition."

-Participant R11

"There was such a significant pannus that we were trying to figure out where we were going to make the incision. We didn't want to put it under the pannus because that is just a nest for infection. If we went through the pannus, it is just a long dissection to get in, so, we weren't really sure about that either. We finally settled on a spot and started."
-Participant R4

Residents emphasized that perhaps the patients they were most concerned about had obesity related comorbidities. Many discounted the idea of the 'healthy obese' person and instead felt that "obesity itself does put strain on your body systems independently of the other comorbidities, so…you [can't] be fully healthy with obesity" (*Participant R4*). Participants described specific maternal comorbidities including gestational or type 2 diabetes, hypertensive disorders of pregnancy, dyslipidemia, and osteoarthritis that would push them to considering a patients as high risk from obesity. Fetal conditions including LGA, macrosomia, IUGR and hydramnios were also cited as important indications of how obesity could affect the maternal-fetal unit. Obstetrics patients are traditionally young and healthy and have their first regular interactions with health care providers during pregnancy. Residents recognized that because of this traditional view of pregnant women as healthy, care providers may be naïve to a patient's true health status. Medical comorbidities may therefore go under-recognized and investigated.

"I feel like a lot of these patients haven't been tested so we actually just might not know how unwell they are. In other settings, like pre-operatively, it is noted a lot more. Probably some of these patients in pregnancy have dyslipidemia or hypertension but we just haven't tested it yet."
-Participant R6

Residents were unable to identify how much overweight and obesity increased a patient's risk of medical complications in pregnancy. Some ascribe minimal risk from

obesity and felt it contributed only "some small degree" to patients developing sequelae like gestational diabetes and hypertensive disorders of pregnancy. Others describe a positive correlation between BMI and risk: "the higher the BMI, the greater the risk". While there was no consensus on how much obesity would increase a patient's risk, residents did agree that gestational diabetes would likely be the first comorbidity seen secondary to obesity.

"I think we use gestational diabetes as our line between someone who is a little bit heavier and unhealthy, and someone who is heavier but healthy."
-Participant R9

3.3.5   CLINICAL DECISION-MAKING IS AFFECTED BY OBESITY:

In various different ways, respondents highlighted that obesity in and of itself could alter clinical decision making. This was highlighted by recurrent discussions of alterations in delivery planning. Residents recognize that care providers are "definitely intervening more" when caring for women with obesity. For example, many respondents commented on how inductions of labour were often booked for maternal obesity without any other indication for induction. Alternatively, patients would sometimes be booked for elective caesarean sections with obesity as the indication. Residents recognize that delivery planning is aimed at avoiding an emergency caesarean delivery as they are not only more difficult to perform from a provider's perspective but result in higher levels of patient complications and maternal morbidity. Having to do an emergency caesarean section was repeatedly described as a "disaster" situation. There was no clear threshold described for when delivery planning would, or should, be changed.

"I think definitely the approach to [calling] a C-section or not changes because there is recognition that this is going to be more morbid, more difficult to complete and so people don't want to get themselves into a situation where there is an emergency C-section. I think we are way quicker to throw in the towel to avoid that scenario."
-Participant R6

3.3.6 OBESITY CAN CREATE PHYSICAL AND MENTAL BARRIERS TO PROVISION OF CARE:

        Throughout the interviews, residents highlighted that obesity can complicate provision of care. They repeatedly cited the direct physical limitations obesity can have on the provision of typical obstetrical care. For example, respondents unanimously highlighted the challenge of assessment of fetal wellbeing with NSTs.

"There have been patients where we are trying to get a tracing, but we just couldn't. And she's reporting decreased fetal movements so that's an issue because we have to make sure the baby is OK. But the nurse was in there, holding the monitor for like 20 minutes…eventually by the end we got it for only 20 seconds… so what can you do?"
-Participant R1

        Physical exams such as cervical exams and minor procedures like insertion of alternate monitoring devices including IUPCs or fetal scalp electrodes were also reported as more difficult and time consuming in women with obesity. Many residents also acknowledge that providing extra care can be mentally and physically more difficult as they are "a little bit more stressed" and that caring for these patients is "quite a bit more physical work". Extra stress and work led residents to approach patients with obesity with negativity. Despite this, they aim to "create a safe space for the patient free of judgement". Residents recognize that frustration is not only theirs but that patients with obesity are more likely to have a negative experience when accessing health care. When aspects of their care are difficult for care providers to execute, patients may feel uncomfortable and self-conscious about their weight and its effects.

"Even if I don't consciously think about it, you are subconsciously acknowledging that this patient is heavier. And some things on my mind are that this is going to be a more difficult cervical exam, more difficult to do a Foley or IUPC, it might be harder to monitor her… and I'm thinking - oh, if we have to do a C-section, this is going to

be a TERRIBLE section. All of those things are running through your head as you
are meeting the patient."
-Participant R12

"I don't like that I have the thought, but if I see extreme obesity, I know it is going to
be difficult. It takes more out of you as a healthcare provider. It is more work for us.
It is not fun. It's nice to have easy deliveries but that is the exception now."
-Participant R8

"I saw one patient coming in for a wound assessment after a C-section, and even just
doing the exam, I had to actually lift her pannus up…. At some point I needed two
hands and I actually had to have her hold it up. Even just that – just asking her to
hold this up was…just awkward. She was uncomfortable. I was definitely
uncomfortable. She was very, very frustrated by the care she got."
-Participant R6

3.3.7 <u>WEIGHT COUNSELING IS A CHALLENGING BUT ESSENTIAL COMPONENT OF</u>
<u>PREGNANCY CARE:</u>

        In all interviews the importance of communication about obesity as a health issue
was brought up. Discussions about weight were often described as "awkward",
"uncomfortable", "hard" or "tough". Residents described that discussions about weight in
the acute-care setting is especially challenging because they are typically meeting a patient
for the first time and often hurried. They emphasized that ideally conversations about
weight would occur in pre-natal appointments and be documented for acute-care providers
to clearly see. This way, should the topic be broached in an acute-care setting, for example
during labour or during a discussion of consent for caesarean section, patients are less
likely to be surprised and offended. Additionally, residents admitted a reluctance to
engage in weight counselling of any form as they felt their efforts would fail to impact a
patient's weight or health habits in a positive way.

"I think it's hard because you are meeting someone for the first time in a very important time in their life and you don't have an established relationship with them. You aren't going to do more than 12-24 hours of care for them. And you aren't going to see them afterwards. Your goal is to care for them in labour or whatever they are coming in with. My focus is on that problem. I can't change what has already happened. I can't change that they are overweight."
-Participant R5

Residents were aware that obesity is a highly stigmatized disease. They highlighted that obesity, unlike other diseases, is visually apparent and often obvious making it easier to negatively stigmatize women with obesity. Residents were wary of further stigmatizing their patients thereby creating an uncomfortable and negative experience with health care. Residents felt they lacked sensitive communication strategies to discuss weight. This trepidation was repeatedly cited as a barrier to initiating discussions about weight.

"It's also sensitive because I don't think people need to be told they are obese. I think they know they are obese even if they haven't called themselves obese before. I think that's part of why we don't bring it up. You can't tell if someone has diabetes just by looking at them, but you can tell if someone is obese just by looking at them…and they already know they aren't skinny."
-Participant R9

"We ask everyone about their past medical history, but we never say obesity out loud. I will add it to the written chart though. I think that's part of not wanting to body shame people. Not wanting to make them feel bad because it's something people already feel badly about."
-Participant R10

Contrasting this reluctance to talk about obesity was a feeling of professional obligation to do so. They emphasized that uncomfortable conversations are part of medical practice and should not get in the way of delivering important information to patients about

modifiable risk factors like obesity. Residents felt patients would want to know the risks they face and that they were entitled to know that their weight would be impacting and potentially complicating their course. Two participants felt that such omissions could be considered negligent.

"When we talk about morbidly obese patients, we are all dancing around the topic [because] we are trying not to offend. We are trying not to make [patients] uncomfortable when these patients are already in a vulnerable position but, you know, who are we [benefiting] by NOT at some point using the word 'obese' or 'high BMI' so they also know it's a health risk. What is our responsibility as health care practitioners to do that? I'm not your friend. I'm not supposed to be treading this line where I can only say 'nice' things to you. Yes, I am bound by professionalism and need to be compassionate but my job at the end of the day is your health. And if we have identified a parameter that has higher risks associated with it, it would be in my mind, professional negligence, to not say that."
-Participant R2

"I think moms want to know. They want to do the best by their babies. And if no one ever said [obesity] is a risk factor, I think they would be frustrated."
-Participant R8

3.3.8   IMPROVED EDUCATION ABOUT OBESITY IN PREGNANCY IS NEEDED:

Residents unanimously cited that lack of education about obesity in pregnancy eroded confidence in caring for this population of patients. Without confidence in their knowledge they will abandon conversations about weight.

"I haven't brought [obesity] up with patients… partly because I don't know the actual stats – I don't want to make it up. I don't have the background to have an effective conversation."
-Participant R3

One reason for this lack of knowledge is a reported lack of formal education about obesity both in medical school and residency. Residents report that most of their education is experience based. That is, residents learn how to manage women with obesity from senior residents and staff physicians based on experiences during residency. One participant explained that learning this way can lead to biased approaches that are not based on current evidence but rather local practice patterns and culture. Care providers often approach similar patients differently and can further confuse learners, undermining their confidence for counselling and management.

"We are seeing so many obese patients and I don't think I have a really clear idea of what I should be doing with who. I just kind of go by what my colleagues are doing. But when everyone has a different idea of what to do, I feel like I get more confused about what to do, or [what to] talk to patients about."
-Participant R9

"I am influenced by the people around me. And so staff and other residents saying 'oh, this one is going to be really challenging' or 'watch out for this or that' and I match those experiences with that body type which is potentially really dangerous if it doesn't turn out to be completely true, really evidence based, then that is a really dangerous and unfair way to practice."
-Participant R8

All participants expressed interest in learning more about obesity. Residents feel their current knowledge is superficial. They are aware that obesity can increase the risk of some complications. However, they were unsure of which specific complications were more likely in patients with obesity and to what extent risks were augmented. Further, they do not have a structured approach to help them counsel patients or develop evidence-based care plans for those suffering from obesity.

"We need a better understanding of the risks that face these patients. If we had some sort of teaching on this topic in residency or even in medical school, I would be interested in it."
-Participant R1

"I don't think [obesity] is something that comes up as a topic in and of itself. We don't have academic days about this…there is no standardized approach to this, and it isn't something we are formally taught"
-Participant R11

The importance of prioritizing education efforts for obesity in pregnancy was highlighted by one resident who explained that with the prevalence of obesity now being so high, care providers need to develop better care plans.

"I just think, I guess… the main part for me is there are so many unknowns. It is uncomfortable the degree to which I find myself giving people advice or suggesting there is risk or suggesting courses of action based on obesity as a risk factor but not knowing what it is or how exactly to define it. I don't know how to reduce their risk in an evidence-based way, either. And that would be fine if we were talking about something rare like hemochromatosis in pregnancy – but something that affects 20-30% of our patients – that is NOT acceptable."
-Participant R7

3.4   DISCUSSION:

Women of reproductive age are increasingly affected by obesity. Roughly half of the female patients OBGYNs see are overweight or obese.[10] This high rate of exposure to excess adiposity can lead to visual normalization or habituation, the process where a decline in behavioural response is seen secondary to repeated stimulation or exposures to a certain stimulus.[173, 178] Simply put, with repeated interactions with women with overweight and obesity, a clinician's ability to both recognize and react to excess weight

is diminished. Obstetrics residents recognized their own habituation citing that it took an extremely high body mass for them to consider obesity as a contributor to patient risk. Although no studies are available for the obstetrical population, in primary care a doctor's recognition of overweight and obesity is demonstrated to be low, with only 20-30% of overweight patients and 50-65% of obese patients being recognized.[175] With the changes to body shape and the physiologic weight gain of pregnancy, accurate recognition of overweight and obesity in pregnancy is more difficult and likely more poorly executed. A lack of appreciation of obesity is significant because risks of pregnancy complications including hypertensive disorders of pregnancy, GDM, LGA and macrosomia increases with even small increases in pre-pregnancy BMI. Given that roughly 24% of all pregnancy complications are attributable to overweight and obesity, accurate recognition of these conditions is paramount for planning and prevention.[171]

Objective measures can provide a reliable, unbiased approach to assess patient size. BMI is a commonly used metric to identify patients with overweight (BMI 25.0 – 29.9kg/m^2) or obesity (BMI ≥30 kg/m^2). It is calculated using a person's weight in kilograms divided by their height in meters squared. An objective measure like BMI can facilitate early recognition of excess adiposity before it reaches an 'extreme' stage. Simply recording BMI and recognizing obesity on a problem list increases the likelihood that a physician will take steps to manage obesity.[179] While the Alberta prenatal record encourages measurement of BMI at the first pre-natal appointment, further assessments are not included on the form. Adopting more consistent use of this or other metrics, like total GWG, would allow reliable screening of pregnant women for a disease that carries significant health implications.

With the evolving understanding of obesity, it is becoming clear that its pathophysiology is complex, and its effects are far reaching. Obesity can affect patients in all aspects of health: mental, physical and psycho-social. With obesity now being recognized as a chronic disease by organizations like the Canadian and American Medical associations, emphasis is being placed on the consequences of excess adipose rather than simply on patient size. Thus, the use of BMI, a simple measure of body size, is now insufficient as the sole diagnostic criteria for obesity. More comprehensive assessment involving history taking, physical exam and possibly basic investigations

should be considered to establish this diagnosis.[143] Obstetrics residents consistently reported using a 'clinical gestalt' to classify patients as obese or not. This 'gestalt' included not only an objective measure of obesity, like BMI, but also weight distribution, the presence of any medical comorbidities, and whether the distribution of adipose tissue could impede the delivery of care. Their desire to capture a more global picture of a patient's health is a contemporary reflection of how obesity experts are suggesting obesity in the general population be defined. For example, the EOSS provides a more comprehensive assessment of how patients are affected by obesity by looking at health from a physical, mental and functional perspective.[6] Patients are staged from 0 – 4 depending on the extent to which their excess weight is affecting their health. A stage 0 would reflect a patient with obesity with no apparent obesity related risk factors, while a patient with stage 4 obesity would have severe, possibly end-stage obesity related disease.[6] The EOSS is a superior predictor of mortality compared to BMI[180] which on its own is a relatively unreliable predictor of morbidity and mortality.[181] Post-operative complications after metabolic surgery can also be predicted, in a stage dependent manner, with the EOSS.[182] The obstetrics resident's desire to capture patient health in a broader context is in line with this contemporary, evidence-based approach increasingly used outside of pregnancy.

Communicating with patients about obesity is challenging but important. Residents worry about offending patients and cited lack of knowledge about obesity in pregnancy as a barrier to engaging in discussions about weight, weight loss and weight related risks. Residents expressed that "it is nice when you can quote some science or say you are following a guideline in this situation. It would make [discussions of weight] much easier" (*Participant R3)*. Obstetrics residents are not alone in this sentiment. Many physicians feel ill-equipped to start conversations about weight management.[183] They cite a lack of training and a perceived sense of futility in helping patients achieve a healthy weight as significant barriers to initiating weight counseling.[184] In a study looking at doctors from different specialties, only half felt qualified to discuss weight related issues.[185] Physicians felt more empowered to address weight, however, when patients developed comorbid conditions that were related to obesity. This allowed for an indirect entry point to discuss weight by focusing on the comorbid condition rather than

obesity specifically.[183] Obstetrics residents iterated that, similarly, they are more informed and more confident discussing medical complications related to obesity than obesity itself. Unfortunately, if physicians are waiting for patients to develop comorbidities before addressing this subject, opportunities to prevent these sequelae are being missed. To overcome this barrier OBGYNs and residents of this specialty would benefit from competency based training and education about obesity and weight management in pregnancy.[186]

Residents may also be avoiding conversations about obesity because they harbour negative bias, be it implicit or explicit, for women with obesity. Those interviewed recognize they occasionally adopt an attitude of blame toward patients with obesity. They find themselves justifying abdication of professional responsibility to counsel, "slipping into that jadedness and that mentality of 'I don't care if you won't care'" (*Participant R10*). Residents may not realize that patients do care and in fact not only want but expect their obstetrical care provider to initiate discussions of weight.[123] Patients want to know about obesity and strategies for preventing worse disease.[187] OBGYNs provide longitudinal care over the course of a pregnancy which is often a woman's first experience with regular and frequent health care visits. As such, OBGYNs are uniquely poised to capitalize on a growing therapeutic relationship built over the course of a pregnancy and to provide meaningful and consistent advice about establishment of a healthy weight. The regular contact a patient has with their health care provider, and because pregnancy is a health event thought to motivate soon-to-be mothers to more readily adopt risk reducing health behaviours, pregnancy can be a powerful 'teachable moment.'[188] To overcome barriers such as heavy workloads and time constraints counselling strategies need to be both efficient and effective. Approaches such as the 5As for obesity management (Ask, Assess, Advise, Agree, Assist) are gaining traction as they provide a simple mnemonic for patient centered counseling. This approach is associated with increased patient motivation to engage with weight management plans.[189, 190] By empowering physicians with evidence-based knowledge and tools to engage these patients, opportunities for improving maternal and fetal health can be realized.

3.5   STRENGTHS AND LIMITATIONS:

To my knowledge, this is one of the first studies looking at defining obesity in pregnancy and the first study seeking OBGYN resident's perspectives on this definition. The participant population, although predominantly female, is reflective of the sexual distribution of young physicians in obstetrics and gynecology residency in Canada. While all participants are currently residents at the University of Alberta, they are truly a diverse group with wide ranging educational backgrounds, having completed medical school and other degrees in different parts of Canada and the world. Many are not native to Alberta. This diversity provides greater perspective and richness to this data. However, findings are not meant to be generalizable from this method of inquiry. All participants were in their first three years of residency and whether increasing seniority and experience influences how obesity would ideally be defined, is unknown.

3.6   CONCLUSIONS:

Obstetrics residents rely on varying subjective measures to classify patients with obesity or not. They find BMI useful but overall inadequate and would prefer a definition of obesity that incorporates a more comprehensive picture of patient health and wellbeing. Adopting the inclusion of medical comorbidities and weight distribution may help to increase the overall utility of measuring obesity in pregnancy. In addition, establishing a consensus definition and classification scheme of obesity in pregnancy would allow for more standardized patient care.

Limited education opportunities, lack of specific counseling tools, time constraints and negative bias toward women with obesity in pregnancy all act as barriers to providing evidence-based care to women with obesity. Education strategies addressing these barriers will help empower obstetrics residents to become champions of weight management in the future. As described by the Royal College of Physicians "Regardless of the particular discipline of the health professional, or the setting in which he/she works, the message that needs to be heard, is that managing overweight and obesity is everybody's business."[191]

4   OVERALL CONCLUSIONS AND FUTURE DIRECTIONS:

4.1   CONCLUSIONS:

Overlapping themes emerged from both studies. Both resident and staff OBGYNs use different clinical definitions of obesity in pregnancy. Clinicians have different thresholds for classifying obesity and obesity related risk which are primarily based on subjective and varying criteria. Many clinicians rely on visual inspection to classify a patient as having obesity and fail to recognize obesity until it is severe. Weight distribution, especially that which might affect fetal assessment or surgical planning, was seen as important for risk assessment. Objective measures of obesity, such as BMI, are not routinely used.

Barriers to caring for women with obesity were also identified. Clinicians at all levels struggle to communicate with their patients about weight and weight-related risk, especially if their patients have obesity. Additionally, lack of education about obesity, its implications in pregnancy, and sensitive communication strategies prevents OBGYNs from confidently engaging in dialogue about this disease. Overall, OBGYN physicians at both the resident and staff level are motivated to learn more about obesity in pregnancy. However, OBGYNs felt guidelines are inadequate and better evidence based educational resources are needed.

I hope this research will serve to increase awareness about obesity as an important disease affecting reproductive aged women. As obesity's prevalence continues to risk, it is a disease that urgently needs the attention of the obstetrical and medical communities at large. As obstetricians engage regularly with women over the course of a pregnancy, they are uniquely poised to make affect positive change in the health of these patients.

4.2   FUTURE DIRECTIONS:

As a result of this work new areas of inquiry are being considered. Some ideas are presented below:

1) In this sample population there was no consensus definition of obesity in pregnancy and clinicians use differing criteria to understand obesity and obesity related risk. Review of the literature suggests that there are numerous definitions in play in published works. I propose a scoping review to identify all of the various definitions currently in use. The aim of this would be to highlight the number of different definitions and lack of consensus thereby making extrapolation and application of research findings challenging. Also, the review will allow for careful analysis and consideration of these definitions to inform development of a consensus definition of obesity in pregnancy in the future.

2) Developing an evidence-based, consensus definition of obesity in pregnancy would be helpful to clinicians, researchers and patients, alike. Such a definition should be predictive of risk and indicative of patient health status. It must be easy to use in clinical practice. In these studies, obstetrical care providers highlighted criteria that were important to them in the management of persons with obesity and what they would like to see included in a definition. These recommendations should be assembled, along with important defining criteria identified in the proposed scoping review, to form a proposed definition and clinical staging system for women with obesity in pregnancy. Attempts to validate this definition would be required.

3) Poor knowledge translation and education were identified as barriers to beginning dialogues with patients about obesity in pregnancy. I propose a quality improvement project to address this issue. A survey could be designed to assess how often and with what level of confidence OBGYNs and residents are engaging in weight education and counseling with their patients. Once a baseline assessment is complete an intervention in the form of an online learning module could be completed. This module would provide information about evidence-based counseling practices for patients with obesity. After the intervention, a follow-up survey could be delivered to assess whether confidence or frequency were affected.

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APPENDIX A

Please circle or mark with an 'X' your response to the following:

SECTION 1: During **pre-natal** appointments,

a)	I consider a patient to be high risk because of body weight when their body mass index (BMI) exceeds:	_____ (Please write number)				
b)	I refer patients with obesity to anaesthesia prior to delivery when their BMI is:	30 – 34.9	35 – 44.9	45 – 54.9	>55	I do not routinely refer.

		YES	NO
c)	I book longer appointments for patients with obesity.		
d)	Appointments often take longer for patients with obesity.		
e)	I book extra pre-natal appointments for my patients with obesity.		
f)	I talk to patients about their weight at every visit.		
g)	I calculate and record BMI at every pre-natal visit.		
h)	Talking about gestational weight gain (GWG) with patients is easy.		
i)	Talking about body weight and GWG is more difficult when a patient is overweight or obese.		
j)	I am nervous I will offend patients by talking about gestational weight gain.		
k)	I explain why excessive weight gain and obesity are medically important in pregnancy.		
l)	I provide specific, numerical weight gain targets for my patients.		
m)	I believe pregnant patients with obesity want to talk to their health care providers about their weight and weight gain targets.		
n)	I believe counselling will be effective at helping women gain appropriate amounts of weight in pregnancy.		
o)	Generally, I request more ultrasounds in patients with obesity.		
p)	I counsel about increased risk of complications and interventions at time of delivery secondary to obesity.		
q)	I feel well equipped and trained to counsel pregnant women about how to achieve healthy GWG.		

SECTION 2: The following statements pertain to **induction of labour** in patients with obesity:

		YES	NO
a)	Obesity should be an indication for induction.		
b)	I use the same induction methods as for patients of normal weight.		
c)	Inductions of labour are less successful than in patients of normal weight.		

			YES	NO
d)	I prefer mechanical induction (ex. Foley catheter) over prostaglandins.			

SECTION 3: When preparing and doing a **caesarean section** (CS) for a patient with obesity compared to a patient of normal weight:

					YES	NO
a)	my surgical approach and management are unchanged compared to a normal weight patient.					
b)	I expect more complications.					
c)	I have an overall **lower** threshold for CS (i.e. will do CS more readily).					
d)	my preference is to do these CSs during the day.					
e)	I prefer to close skin with:		staples		sutures	other
f)	my preferred incision is:		transverse		midline	
g)	my preferred dressing is:	Routine dressing (ex. Mepore)	Honeycomb dressing	PICO	Other	

SECTION 4: During **labour**, when managing a patient with obesity compared to a patient with normal weight, I:

		YES	NO
a)	expect longer first stages of labour.		
b)	expect longer second stages of labour.		
c)	expect longer third stages of labour.		
d)	routinely request continuous fetal heart rate monitoring.		
e)	use more fetal scalp electrodes.		
f)	use more intra-uterine pressure catheters (IUPCs).		
g)	often use higher doses of oxytocin to induce and/or augment labour.		
h)	avoid labour by offering elective caesarean delivery.		

SECTION 5: In the **post-partum** period, when managing a patient with obesity compared to a patient of normal weight, I:

		YES	NO
a)	expect them to have longer hospital stays immediately post-partum.		
b)	provide venous thromboembolism (VTE) prophylaxis after vaginal delivery.		
c)	provide VTE prophylaxis after elective CS.		
d)	provide VTE prophylaxis after emergency CS.		
e)	see patients earlier post-partum than the usual six-week check-up.		
f)	see patients with obesity more often than at just their six-week check-up.		

g)	specifically focus on weight loss counselling at post-partum appointments.		
h)	routinely offer referrals to weight loss clinics or other weight loss resources.		

SECTION 6: Please indicate 'yes' or no' to the following statements about education and knowledge translation:

		YES	NO
a)	Overall, I feel up to date on current evidence about managing women with obesity in obstetrics.		
b)	The current SOGC guidelines provide sufficient information to manage patients with obesity in pregnancy.		
c)	Additional guidelines addressing pre-natal, intra-partum and post-partum care of women with obesity would be useful to me.		
d)	There are easy to access, up to date resources that review the current evidence on how best to manage patients with obesity.		

SECTION 7: Demographics:

a)	I practice primarily in a:	Rural Center		Urban Center	
b)	Which option best describes your level of training?	Fellow		Staff OBGYN	OBGYN with Fellowship training
c)	I have been in practice for _____ years.	<5	5-10	11-15	>15
d)	I estimate that I attend _____ deliveries annually.	0 -100	101 - 250	251 – 500	>500
e)	What percentage of your prenatal patient population would you estimate has obesity (BMI>30)?	<25%	25-50%	51-75%	>75%

**Thank you for your
participation!**

APPENDIX B:

- So how is residency going so far? Are you settling in alright?
- Have you encountered obesity a lot on your rotations so far?
- What about your OB rotations?
- When you are getting handover, is weight or obesity something that would often be flagged?
    - o Tell me about what those patients were like?
- When you are caring for patients with obesity on labor and delivery, do you get more nervous about treating them than normal weight patients?
    - o Why?
- You have mentioned that x, y, z makes you more apprehensive when caring for women with obesity in pregnancy. What is it about those variables that makes you nervous?
    - ▪ How reliably do you learn about these things on handovers?
    - o Ask about the following specifically if not brought up spontaneously:
        - ▪ Comorbidities like GDM, DM2
        - ▪ Hypertensive disorders of pregnancy
        - ▪ Weight distribution
        - ▪ Total body weight or BMI
        - ▪ Example: Other people have commented that weight distribution is an important variable to them. How does that impact your approach/assessment of risk/decision making at all?
- There are a few different definitions of obesity in pregnancy. Most commonly we use BMIs to understand whether a patient is obese or not. Do you find BMI to be a helpful tool to understand a patients' risk of adverse maternal or fetal outcomes?
    - o If yes:
        - ▪ What do you like about BMI?
        - ▪ Do you measure it or use self-reported values?
        - ▪ What threshold of BMI do you find conveys a serious risk or would classify as a patient as high risk based on their weight?
    - o If no:
        - ▪ What do you find BMI misses or fails to convey?
        - ▪ What is your preferred measure?
            - • Weight
            - • General gestalt/weight distribution
            - • Pre-pregnancy weights
- Outside of pregnancy, BMI>30 is the criteria for having a diagnosis of obesity. Do you think that women with a BMI of 30 should be considered to have obesity at term?
    - o What is your threshold for considering a woman high risk based on BMI?

- We expect patients to gain weight in pregnancy and so their BMI is going to go up throughout. How do you think we should adjust our understanding of obesity in pregnancy given that we expect patients to gain weight in pregnancy?
- Obesity is becoming increasingly prevalent. Do you think that because it is so common, we are missing noticing and flagging it as a risk factor?
- How do you perceive a patients' risk when they are BMI 25 – 30?
- If you could describe the ideal way to define obesity in pregnancy, what would that include?
    - OR: If you were handing over or getting handover about a patient with obesity, what descriptors are most valuable to you in order for you to assess their risks?
    - Some obstetricians have mentioned that they use a general impression, or a gestalt of a patient based on visual inspection to assess a patient's risk in pregnancy. If you were looking at a patient with obesity and you're taking them in front the foot of the bed, what are you looking for that would help you assess their risks during pregnancy or labor and delivery?
- If there was a definition of obesity that involved a quick two- or three-point scoring system, do you think that would be too cumbersome to use in a busy place like labor and delivery or is that doable?
- You have given me a lot to think about! Is there anything else you wanted to add that I haven't asked about?

Prompts:
- Could you tell me a little more about…….
- What was it like in comparison to…….
- What happened next…
- Describe how you felt…

APPENDIX C:

SAMPLE CONCEPT MAP