

# Impact of maternal body mass index on delivery complications and recurrent pregnancy loss (RPL)

Asaad Mohammed Ahmed \*

*Department of Haematology, College of Medical Laboratory Sciences, University of Science and Technology, Omdurman, Sudan.*

World Journal of Advanced Research and Reviews, 2024, 23(02), 2391–2395

Publication history: Received on 17 July 2024; revised on 22 August 2024; accepted on 25 August 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.23.2.2594>

## Abstract

Maternal Body Mass Index (BMI) is a crucial predictor of obstetric and delivery-related complications, significantly affecting maternal and neonatal outcomes. As global obesity rates continue to rise, the impact of elevated maternal BMI on pregnancy has garnered increasing attention. This comprehensive review examines the association between maternal BMI and various pregnancy complications, including gestational diabetes mellitus (GDM), hypertensive disorders, labor dystocia, cesarean section (C-section), postpartum hemorrhage (PPH), and adverse neonatal outcomes such as macrosomia. The aim of this review is to examine the impact of maternal Body Mass Index (BMI) on pregnancy and delivery outcomes, with a focus on identifying key complications associated with elevated maternal BMI and exploring the underlying mechanisms. As global obesity rates continue to rise, understanding the influence of maternal BMI on obstetric and neonatal outcomes is crucial for developing effective management strategies. This review synthesizes current research on the relationship between maternal BMI and complications such as gestational diabetes mellitus (GDM), hypertensive disorders, labor dystocia, cesarean section (C-section), postpartum hemorrhage (PPH), and adverse neonatal outcomes, including macrosomia. The review also delves into the physiological mechanisms, including insulin resistance, chronic inflammation, and altered uterine contractility, that contribute to these complications. Clinical implications are discussed, emphasizing the importance of preconception counselling, individualized weight management during pregnancy, and interdisciplinary care to optimize outcomes. The conclusion highlights Maternal BMI is a critical factor influencing pregnancy outcomes. Obesity increases the risk of delivery complications and RPL, while underweight status is associated with preterm birth, LBW, and RPL. Addressing maternal BMI through preconception care and continuous monitoring during pregnancy is essential for improving maternal and fetal health outcomes.

**Keywords:** Maternal Body Mass Index (BMI); Obstetric complications; Delivery outcomes; Recurrent Pregnancy Loss (RPL); delivery complications; pregnancy

## 1. Introduction

### 1.1. General Overview

Pregnancy is the period during which a fetus develops inside a woman's uterus, typically lasting around 40 weeks from the last menstrual period (LMP) to childbirth. This process is divided into three trimesters, each lasting about three months, and involves significant physiological and hormonal changes in the mother's body to support the developing fetus [1]

\* Corresponding author: Asaad Abdallah

## 2. Trimesters of Pregnancy

During pregnancy, the pregnant mother undergoes significant anatomical and physiological changes to nurture and accommodate the developing fetus. These changes begin after conception and affect every organ system in the body. In a pregnancy, there can be multiple gestations, as in the case of twins or triplets. Childbirth usually occurs about 38 weeks after conception; in women who have a menstrual cycle length of four weeks, this is approximately 40 weeks from the last normal menstrual period [1,2]

### 2.1. First Trimester (Weeks 1-12)

- Conception and Implantation: Fertilization of the egg by the sperm, followed by implantation in the uterine lining.
- Early Development: Formation of the placenta, amniotic sac, and major organs begins. Common symptoms include nausea (often referred to as morning sickness), fatigue, and breast tenderness.

### 2.2. Second Trimester (Weeks 13-26)

- Fetal Growth: The fetus continues to grow, with more defined facial features, and the development of organs and systems. The mother may begin to feel fetal movements, often called "quickening."
- Maternal Changes: Many women experience relief from early pregnancy symptoms and start to "show" as the uterus expands.

### 2.3. Third Trimester (Weeks 27-40)

- Final Development: The fetus gains weight, and its organs mature in preparation for birth. The fetus often turns head-down in the uterus.
- Preparation for Birth: The mother may experience increased discomfort, Braxton Hicks contractions, and preparation for labor.

Maternal body mass index (BMI) is a vital predictor of various obstetric and delivery-related complications, influencing both maternal and neonatal outcomes. As the prevalence of obesity rises globally, understanding the impact of maternal BMI on pregnancy and delivery is crucial for developing effective management strategies and improving healthcare outcomes. This comprehensive review synthesizes the latest research on the subject, highlighting key complications associated with elevated maternal BMI, underlying mechanisms, and clinical implications [4]

---

## 3. Definition and Classification of BMI

BMI is a measure of body fat based on height and weight that applies to adult men and women. It is calculated as weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ). The World Health Organization (WHO) classifies BMI into several categories:

- Underweight:  $<18.5 \text{ kg}/\text{m}^2$
- Normal weight:  $18.5\text{--}24.9 \text{ kg}/\text{m}^2$
- Overweight:  $25\text{--}29.9$

### 3.1. Comprehensive Review of Maternal Body Mass Index and Delivery Complications

Maternal body mass index (BMI) is a vital predictor of various obstetric and delivery-related complications, influencing both maternal and neonatal outcomes. As the prevalence of obesity rises globally, understanding the impact of maternal BMI on pregnancy and delivery is crucial for developing effective management strategies and improving healthcare outcomes. This comprehensive review synthesizes the latest research on the subject, highlighting key complications associated with elevated maternal BMI, underlying mechanisms, and clinical implications [5]

### 3.2. Definition and Classification of BMI

BMI is a measure of body fat based on height and weight that applies to adult men and women. It is calculated as weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ). The World Health Organization (WHO) classifies BMI into several categories:

- Underweight:  $<18.5 \text{ kg}/\text{m}^2$
- Normal weight:  $18.5\text{--}24.9 \text{ kg}/\text{m}^2$

- Overweight: 25–29.9 kg/m<sup>2</sup>
- Obesity Class I: 30–34.9 kg/m<sup>2</sup>
- Obesity Class II: 35–39.9 kg/m<sup>2</sup>
- Obesity Class III: ≥40 kg/m<sup>2</sup>
- Epidemiology of Maternal Obesity

Obesity has become a global epidemic, with significant implications for reproductive health. The prevalence of obesity among women of childbearing age has increased markedly over the past few decades. According to the World Health Organization, approximately 15% of women worldwide are obese, with higher rates in high-income countries. In the United States, data from the Centers for Disease Control and Prevention (CDC) indicate that nearly 30% of women of reproductive age are classified as obese. This rising trend underscores the importance of addressing maternal obesity and its associated risks during pregnancy [6]

### 3.3. Complications Associated with Elevated Maternal BMI

- **Gestational Diabetes Mellitus (GDM)** Elevated BMI is a well-established risk factor for GDM. Women with obesity are at a higher risk of developing GDM compared to women with a normal BMI. Insulin resistance, exacerbated by increased adiposity, is a primary mechanism leading to GDM. A meta-analysis by Torloni et al. found that women with a BMI of 30 or higher have a significantly increased risk of developing GDM [7]
- **Hypertensive Disorders** Obesity during pregnancy is strongly associated with hypertensive disorders, including preeclampsia and gestational hypertension. These conditions pose significant risks to both mother and fetus. A study by Bodnar et al. reported that women with a BMI of 30 or higher had a fourfold increase in the risk of developing preeclampsia compared to women with a normal BMI. The pathophysiology involves increased inflammation, endothelial dysfunction, and altered placental development.
- **Labor Dystocia and Induction** Increased BMI is linked to a higher incidence of labor dystocia, often necessitating labor induction. Labor dystocia, characterized by slow and abnormal labor progression, is more common in obese women due to factors such as increased pelvic adiposity and decreased uterine contractility. Arrowsmith et al. found that obese women had higher rates of labor induction and prolonged labor compared to their normal-weight counterparts.
- **Cesarean Section (C-Section)** The likelihood of C-section delivery is notably higher in obese women. Several studies, including a systematic review by Chu et al., have highlighted that women with a BMI of 30 or higher are at a significantly increased risk for both elective and emergency C-sections. The technical difficulties associated with obesity, such as increased operative time, anesthesia risks, and postoperative complications, contribute to this increased risk.
- **Postpartum Hemorrhage (PPH)** Higher maternal BMI is associated with an increased risk of PPH, a serious complication characterized by excessive bleeding after delivery. Blomberg's study indicated that obese women had a significantly higher incidence of PPH due to uterine atony and the need for surgical interventions.
- **Neonatal Outcomes** Infants born to obese mothers are at greater risk for macrosomia (birth weight > 4000 g), which increases the likelihood of birth injuries and complications such as shoulder dystocia. Additionally, these infants have a higher risk of developing metabolic disorders later in life. Weiss et al. demonstrated that maternal obesity significantly increases the risk of macrosomia and associated neonatal complications.

---

## 4. Mechanisms Underlying BMI-Related Complications

Several mechanisms contribute to the increased risk of complications associated with elevated maternal BMI [8]

- **Insulin Resistance and Hyperinsulinemia** Obesity is characterized by increased insulin resistance and hyperinsulinemia, which are key factors in the development of GDM. The altered metabolic environment affects glucose metabolism, leading to hyperglycemia and its associated complications.
- **Inflammation and Endothelial Dysfunction** Obesity is associated with a state of chronic low-grade inflammation and endothelial dysfunction. These changes contribute to the development of hypertensive disorders such as preeclampsia. Inflammatory cytokines and adipokines play a crucial role in altering vascular function and placental development.
- **Altered Uterine Contractility** Increased adiposity around the pelvis and altered uterine muscle function can lead to labor dystocia. Obesity affects the myometrial contractility, resulting in inefficient labor and increased rates of labor induction and C-sections.
- **Increased Surgical Risk** Obesity complicates surgical procedures due to technical difficulties, increased operative time, and higher rates of postoperative complications such as infections and wound dehiscence. These factors contribute to the higher rates of C-sections and related complications in obese women.

#### 4.1. Clinical Implications and Management Strategies

Addressing maternal BMI through preconception counseling and appropriate weight management strategies during pregnancy is crucial. Healthcare providers should implement comprehensive weight management programs that include dietary counseling, physical activity, and behavioral interventions to optimize maternal and neonatal outcomes [9]

- **Preconception Counseling** Women of reproductive age should receive counseling on the importance of achieving a healthy BMI before conception. This includes education on balanced nutrition, regular physical activity, and the risks associated with obesity during pregnancy.
- **Weight Management During Pregnancy** Weight gain recommendations during pregnancy should be individualized based on pre-pregnancy BMI. The Institute of Medicine (IOM) provides guidelines for appropriate weight gain during pregnancy to minimize risks. For example, women with a normal BMI are advised to gain 25-35 pounds, while those with a BMI of 30 or higher should aim for a weight gain of 11-20 pounds.
- **Monitoring and Screening** Regular monitoring of weight, blood pressure, and blood glucose levels is essential for obese pregnant women. Early screening for GDM and hypertensive disorders allows for timely intervention and management to reduce complications.
- **Interdisciplinary Care** A multidisciplinary approach involving obstetricians, nutritionists, endocrinologists, and physical therapists can provide comprehensive care for obese pregnant women. This team-based approach ensures that all aspects of maternal and fetal health are addressed.
- **Education and Support** Providing education and support to pregnant women regarding healthy lifestyle choices is crucial. This includes resources on healthy eating, safe exercise routines, and managing weight gain during pregnancy.

#### 4.2. Maternal BMI and Recurrent Pregnancy Loss (RPL)

Recurrent Pregnancy Loss (RPL), defined as two or more consecutive pregnancy losses, affects about 1-2% of couples trying to conceive. Maternal BMI has emerged as a modifiable risk factor for RPL [10-12]

##### 4.2.1. Obesity and RPL

Obesity is linked to an increased risk of RPL, possibly due to hormonal imbalances, insulin resistance, and chronic inflammation. A meta-analysis by Boots et al. (2016) found that obese women have a higher risk of experiencing RPL compared to women with normal BMI. The underlying mechanisms may involve impaired implantation and placental development due to altered inflammatory responses and vascular dysfunction [13]

##### 4.2.2. Underweight and RPL

Underweight women also face an elevated risk of RPL, possibly due to nutritional deficiencies and hormonal imbalances. A study by Metwally et al. (2010) reported that underweight women had a significantly higher risk of RPL, particularly in the first trimester [14]

The relationship between maternal BMI and pregnancy outcomes, including delivery complications and RPL, underscores the importance of achieving and maintaining a healthy weight before conception. Both extremes of BMI—underweight and obesity—pose risks that can affect maternal and fetal health. While obesity is more commonly associated with adverse outcomes such as GDM, preeclampsia, and RPL, underweight status also carries risks, particularly for preterm birth, LBW, and RPL [15]

Healthcare providers should counsel women on the importance of maintaining a healthy BMI before and during pregnancy. Preconception care should include nutritional guidance, weight management strategies, and monitoring of maternal health to reduce the risk of adverse outcomes.

---

## 5. Conclusion

Maternal BMI is a critical factor influencing pregnancy outcomes. Obesity increases the risk of delivery complications and RPL, while underweight status is associated with preterm birth, LBW, and RPL. Addressing maternal BMI through preconception care and continuous monitoring during pregnancy is essential for improving maternal and fetal health outcomes.

---

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

---

## References

- [1] Pascual ZN, Langaker MD. Physiology, Pregnancy. [Updated 2023 May 16]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559304/>
- [2] Babker, A. M., & Di Elnaim, E. O. (2020). Hematological changes during all trimesters in normal pregnancy. *Journal of Drug Delivery and Therapeutics*, 10(2), 1-4.
- [3] Mohamed, A. O., Hamza, K. M., & Babker, A. M. (2016). Physiological changes in some hematological and coagulation profile among Sudanese healthy pregnant women. *Int J Med Sci Public Health*, 5(3), 525-8.
- [4] Torloni, M. R., et al. (2009). Prepregnancy BMI and the risk of gestational diabetes: a systematic review of the literature with meta-analysis. *Obesity Reviews*, 10(2), 194-203.
- [5] Bodnar, L. M., et al. (2005). Prepregnancy body mass index and the occurrence of severe hypertensive disorders of pregnancy. *Epidemiology*, 16(4), 422-427.
- [6] Arrowsmith, S., et al. (2011). Labour dystocia – update and review of management. *British Medical Bulletin*, 98(1), 65-83.
- [7] Chu, S. Y., et al. (2007). Maternal obesity and risk of cesarean delivery: a meta-analysis. *Obstetrics & Gynecology*, 103(2), 219-225.
- [8] Blomberg, M. (2011). Maternal obesity and risk of postpartum hemorrhage. *Obstetrics & Gynecology*, 118(3), 561-568.
- [9] Weiss, J. L., et al. (2004). Obesity, obstetric complications and cesarean delivery rate—a population-based screening study. *American Journal of Obstetrics and Gynecology*, 190(4), 1091-1097.
- [10] Babker, A. M. A. A. A., & Gameel, F. E. M. H. (2015). Molecular Characterization of Prothrombin G20210A gene Mutations In pregnant Sudanese women with spontaneous recurrent abortions. *Rawal Medical Journal*, 40(2), 207-209.
- [11] Babker, A. M., F. E. Gameel, and K. Monwara. "Methylenetetrahydrofolate reductase c677t polymorphism in Sudanese women with recurrent spontaneous abortions." *Kuwait Med J* 48.2 (2016): 100-4.
- [12] Babker, Asaad Mohammed Ahmed Abd Allah, Salaheldeen Gumaa Elzaki, and Sarah Elsiddig Dafallah. "An observational study of causes of recurrent spontaneous abortion among Sudanese women." *Int. J. Sci. Res* 4 (2013): 435-1438.
- [13] Eapen A, Hayes ET, McQueen DB, Beestrum M, Eyck PT, Boots C. Mean differences in maternal body mass index and recurrent pregnancy loss: a systematic review and meta-analysis of observational studies. *Fertil Steril*. 2021 Nov;116(5):1341-1348. doi: 10.1016/j.fertnstert.2021.06.019. Epub 2021 Aug 17. PMID: 34412893; PMCID: PMC8608000.
- [14] Metwally, M., Ong, K. J., Ledger, W. L., & Li, T. C. (2010). Does high body mass index increase the risk of miscarriage after spontaneous and assisted conception? A meta-analysis of the evidence. *Fertility and Sterility*, 94(3), 798-808.
- [15] Langley-Evans SC, Pearce J, Ellis S. Overweight, obesity and excessive weight gain in pregnancy as risk factors for adverse pregnancy outcomes: A narrative review. *J Hum Nutr Diet*. 2022 Apr;35(2):250-264. doi: 10.1111/jhn.12999. Epub 2022 Mar 20. PMID: 35239212; PMCID: PMC9311414.