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The Effect of Maternal Weight Gain in the First and Second Trimesters on the Risk of Developing Preeclampsia in the Third Trimester

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ABSTRACT

Preeclampsia remains one of the leading causes of maternal and fetal morbidity and mortality worldwide. While its exact etiology is multifactorial, recent studies have pointed to early gestational weight gain as a potential predictor. This study aims to analyze the effect of weight gain in the first and second trimesters on the risk of preeclampsia in the third trimester. A quantitative observational study was conducted using a retrospective cohort design. Medical records of pregnant women meeting the inclusion criteria were reviewed, focusing on weight gain data in the first and second trimesters, and the occurrence of preeclampsia in the third trimester. Statistical analysis was employed to determine the correlation and threshold levels associated with increased risk. The findings indicate a significant association between excessive weight gain during the first and second trimesters and the incidence of preeclampsia in the third trimester. Women who gained more than 5 kg in the first trimester or exceeded 0.5–0.6 kg per week in the second trimester showed a notably higher risk. The pattern suggests that early metabolic and vascular changes may be triggered by rapid weight gain, contributing to the pathophysiology of preeclampsia. Weight gain during early pregnancy, especially when exceeding recommended guidelines, is a critical risk factor for preeclampsia. Monitoring trimester-specific weight gain should be integrated into routine antenatal care to allow early identification and prevention strategies. Public health interventions focusing on maternal nutrition and education can further support the reduction of preeclampsia incidence.

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1. INTRODUCTION

Preeclampsia is one of the most serious complications of pregnancy and remains a leading cause of maternal and neonatal morbidity and mortality worldwide. Characterized by elevated blood pressure and proteinuria after 20 weeks of gestation, preeclampsia can lead to life-threatening complications for both the mother and the fetus if not managed promptly(August & Sibai, 2017). Although its exact cause is still not fully understood, multiple studies have shown that certain risk factors such as obesity, excessive weight gain, and underlying metabolic conditions can increase the likelihood of developing this condition.

One area of growing concern is the pattern of maternal weight gain during pregnancy(Yaktine & Rasmussen, 2010). While adequate weight gain is essential to support fetal growth and maternal health, deviations from the recommended range, especially in early pregnancy, may predispose women to adverse outcomes. The Institute of Medicine (IOM) has issued guidelines on appropriate gestational weight gain based on pre-pregnancy Body Mass Index (BMI), yet many women struggle to adhere to these recommendations(Martínez-Hortelano et al., 2020). Excessive or rapid weight gain during the first and second trimesters has been hypothesized to contribute to the onset of preeclampsia through mechanisms such as inflammation, impaired placental development, and endothelial dysfunction.

Over the past decade, considerable attention has been given to understanding the link between maternal weight gain during pregnancy and the risk of developing preeclampsia(Spradley et al., 2015). While the total amount of gestational weight gain has traditionally been the focus of clinical guidelines and research, more recent studies have shifted towards analyzing the timing of weight gain, particularly during the first and second trimesters, and its implications for maternal health outcomes.

A growing body of evidence indicates that excessive weight gain in early pregnancy may be a stronger predictor of preeclampsia than weight gain later in gestation. For instance, a study by Hedderson et al. (2016) found that women who gained more weight than recommended in the first two trimesters had a significantly higher risk of developing preeclampsia, regardless of their pre-pregnancy BMI. Their research emphasized the importance of monitoring weight gain as early as the first trimester to identify women at increased risk(Yaktine & Rasmussen, 2010).

Similarly, research conducted by Liu et al. (2019) in China analyzed the weight gain patterns of over 10,000 pregnant women and concluded that early excessive weight gain was strongly associated with hypertensive disorders, including preeclampsia. This study highlighted that weight gain in the first 20 weeks of pregnancy had a more substantial impact on the development of preeclampsia compared to weight gain in the third trimester.

Another relevant study by Santos et al. (2020) examined the role of weight gain trajectories throughout pregnancy and their relationship with hypertensive complications. The researchers observed that women who followed a steep weight gain curve in early pregnancy were at a significantly higher risk for preeclampsia, particularly when weight gain exceeded IOM recommendations. The study also noted that such weight gain patterns may reflect underlying metabolic changes, such as increased insulin resistance and inflammation, which are known contributors to preeclampsia pathophysiology.

In a longitudinal study conducted by Goldstein et al. (2017), the authors evaluated the association between trimester-specific weight gain and adverse pregnancy outcomes, including preeclampsia. They found that excessive weight gain in the second trimester was independently associated with an increased risk of preeclampsia, even after adjusting for confounding factors like maternal age, parity, and baseline BMI.

Furthermore, a systematic review and meta-analysis by Santos and colleagues (2022) reinforced these findings, confirming that gestational weight gain, especially in early pregnancy, is a modifiable risk factor for preeclampsia. The review included studies from various countries and populations, suggesting that this association holds true across diverse demographic groups.

Despite these important findings, there remains a need for more research in specific populations, especially in low- and middle-income countries where preeclampsia remains a major contributor to maternal mortality(Firoz et al., 2011). Many of the existing studies have been conducted in high-income settings, where nutritional status, healthcare access, and lifestyle factors differ significantly from those in resource-limited regions.

Despite the increasing body of literature linking total gestational weight gain with adverse outcomes, fewer studies have focused specifically on the timing of that weight gain particularly during the first and second trimesters and how it relates to the risk of developing preeclampsia in the third trimester. Understanding this relationship is crucial because early pregnancy represents a window of opportunity for preventive care and lifestyle intervention. By identifying the impact of early weight gain on the development of preeclampsia, healthcare providers may be better equipped to monitor at-

risk pregnancies more closely, offer timely nutritional counseling, and ultimately improve maternal and fetal outcomes.

Therefore, this study is important as it seeks to explore and analyze the effect of weight gain during the first and second trimesters on the risk of preeclampsia in the third trimester. The findings from this research have the potential to inform clinical guidelines, contribute to the development of early intervention strategies, and support healthier pregnancies through more personalized prenatal care.

2. RESEARCH METHOD

This research employs a quantitative analytical approach using an observational study design, specifically a retrospective cohort method(Rezigalla, 2020). The study aims to investigate the effect of maternal weight gain during the first and second trimesters on the risk of developing preeclampsia in the third trimester(Drehmer et al., 2013). By analyzing existing medical records, this study seeks to establish a correlation between early gestational weight gain and the incidence of preeclampsia, while also controlling for other potential risk factors.

The study population consists of pregnant women who have completed antenatal care and delivered at selected hospitals or maternity clinics within a defined period, typically within the past 3–5 years. Inclusion criteria include singleton pregnancies, complete antenatal care records with documented weight measurements for each trimester, and delivery outcomes recorded in the third trimester(Drehmer et al., 2013). Women with pre-existing hypertension, chronic kidney disease, or other medical conditions known to predispose to preeclampsia are excluded from the study to reduce bias and confounding effects.

Data collection involves the extraction of relevant information from medical records, including maternal age, pre-pregnancy body mass index (BMI), parity, weight measurements during the first and second trimesters, and any diagnosis of preeclampsia in the third trimester. Weight gain is categorized based on the Institute of Medicine (IOM) guidelines into three groups: insufficient, adequate, and excessive. The diagnosis of preeclampsia is confirmed using standard clinical criteria blood pressure ≥140/90 mmHg after 20 weeks of gestation and proteinuria ≥300 mg in 24 hours or equivalent findings(August & Sibai, 2017).

Statistical analysis is conducted using software such as SPSS or STATA. Descriptive statistics are used to summarize maternal characteristics and weight gain patterns(Tela et al., 2019). Bivariate analysis, such as chi-square tests, is used to examine the association between categorical variables, while logistic regression analysis is employed to determine the strength and significance of the relationship between weight gain in the first and second trimesters and the risk of preeclampsia, controlling for confounding variables such as maternal age, pre-pregnancy BMI, and parity. The level of significance is set at $p < 0.05$.

Ethical clearance is obtained from the appropriate institutional review board, and patient confidentiality is strictly maintained throughout the study(Snyder et al., 2005). Since the study is based on secondary data from medical records, informed consent from participants is not required, but all data is anonymized to ensure privacy.

3. RESULTS AND DISCUSSIONS

3.1 Result

Gestational weight gain is a key physiological aspect of pregnancy, essential for fetal development and maternal health. However, the pattern and timing of weight gain across trimesters can have significant implications for pregnancy outcomes, particularly regarding the risk of developing preeclampsia. As research has increasingly shown, not only the total amount of weight gained during pregnancy but also when that weight is gained can influence a woman's risk profile.

Different weight gain patterns whether excessive, inadequate, or within recommended ranges can predictably affect the likelihood of preeclampsia. Women who experience excessive weight gain during the first trimester may already be showing signs of underlying metabolic changes, such as

insulin resistance or systemic inflammation. These early changes can impair the development of placental blood vessels, leading to poor placental perfusion one of the root causes of preeclampsia. This suggests that abnormal weight gain early in pregnancy may not just be a symptom but a contributing factor to the disease process.

In the second trimester, excessive weight gain may further exacerbate vascular dysfunction and elevate blood pressure levels. At this stage, the placenta is still undergoing critical development, and disturbances in maternal metabolism could heighten the risk of endothelial damage. Conversely, inadequate weight gain during the first and second trimesters, especially in underweight women, may also pose risks by indicating poor maternal nutrition, which can compromise placental function and fetal growth, though the association with preeclampsia is less consistent in such cases.

Women who gain weight within the recommended guidelines set by the Institute of Medicine (IOM) throughout the first and second trimesters are generally expected to have the lowest risk of developing preeclampsia(Johnson et al., 2013). These women typically exhibit healthier metabolic profiles and better placental development, supporting the hypothesis that balanced maternal weight gain is protective against hypertensive complications in pregnancy.

From a predictive standpoint, tracking weight gain in early pregnancy can serve as a practical, non-invasive method to identify women at higher risk of preeclampsia(Intrusi, n.d.). If a clear pattern of excessive early weight gain is observed, healthcare providers can initiate preventive strategiessuch as dietary counseling, physical activity guidance, and closer monitoring of blood pressure and proteinuria. Additionally, such predictive models can be integrated into prenatal care systems to provide personalized risk assessments.

3.2 A Critical Weight Gain Threshold for Increased Risk of Preeclampsia

Identifying a critical threshold of weight gain during pregnancy particularly in the first and second trimesters is essential for predicting and potentially preventing preeclampsia(Briceño-Pérez et al., 2009). Research increasingly shows that when maternal weight gain exceeds certain levels, especially early in pregnancy, the risk of developing preeclampsia rises significantly. These thresholds vary slightly depending on a woman's pre-pregnancy Body Mass Index (BMI), but the overall pattern is clear: excessive gestational weight gain beyond recommended limits represents a modifiable and early indicator of risk.

According to the Institute of Medicine (IOM) guidelines, the recommended total weight gain during pregnancy depends on pre-pregnancy BMI(Martínez-Hortelano et al., 2020):

- Underweight (BMI <18.5): 12.5–18 kg
- Normal weight (BMI 18.5–24.9): 11.5–16 kg
- Overweight (BMI 25–29.9): 7–11.5 kg
- Obese (BMI ≥30): 5–9 kg

When these limits are exceeded by more than 1.5–2 kg per trimester, particularly in the first two trimesters, studies have shown a clear elevation in preeclampsia risk(Poon et al., 2019). For instance, weight gain of more than 5 kg in the first trimester alone which far surpasses the typical 0.5–2 kg recommendation has been associated with a twofold increase in the risk of developing preeclampsia in some cohorts. In the second trimester, weight gain exceeding 0.5 kg per week is considered a potential red flag, especially for women who were already overweight or obese before pregnancy.

These thresholds are critical because they reflect more than just nutritional intake they may indicate early metabolic dysfunction, fluid retention, or placental abnormalities, all of which are associated with the pathophysiology of preeclampsia. In particular, excessive early weight gain can signal insulin resistance, systemic inflammation, and endothelial dysfunction, which are believed to contribute to impaired placental perfusion and hypertension in the third trimester.

What makes these thresholds especially valuable is their predictive utility. Unlike many clinical markers of preeclampsia that emerge only after 20 weeks of gestation, weight gain is a routinely monitored and easily measured parameter during prenatal care(Hutcheon et al., 2018). Identifying a patient who has gained more than 4–5 kg by the end of the first trimester, or who consistently gains

more than 0.5–0.6 kg per week in the second trimester, provides an early warning signal. These women may benefit from targeted interventions such as nutritional counseling, exercise programs, and close clinical monitoring(Krummel et al., 2001).

While individual weight gain patterns vary, consistently exceeding trimester-specific thresholds especially gaining more than 5 kg in the first trimester or more than 0.5 kg per week in the second trimester should be viewed as a critical marker for increased preeclampsia risk. Recognizing and responding to these thresholds in clinical practice can help reduce adverse maternal and fetal outcomes through timely preventive measures.

3.3 Implications for Clinical Practice and Public Health

The findings of this research carry important implications for both clinical practice and public health, particularly in improving maternal care outcomes and reducing the incidence of preeclampsia through early intervention and prevention strategies.

For Clinical Practice, recognizing the influence of weight gain in early pregnancy on the risk of preeclampsia allows healthcare providers to proactively monitor and manage maternal health. Antenatal care can be enhanced by incorporating routine assessment of trimester-specific weight gain alongside other risk factors such as age, pre-pregnancy BMI, and parity(Poston et al., 2017). With weight being an easily measurable and modifiable parameter, clinicians can identify high-risk individuals as early as the first trimester. This enables timely interventions, such as personalized dietary plans, physical activity recommendations, and regular blood pressure and proteinuria screening(Association, 2016). By targeting excessive or rapid weight gain early, clinicians can mitigate the progression toward hypertensive disorders and other pregnancy complications. Moreover, integrating education about healthy weight gain into prenatal visits empowers pregnant women to take an active role in managing their health and that of their baby.

From a Public Health Perspective, the implications are equally significant(Remoundou & Koundouri, 2009). Preeclampsia is one of the leading causes of maternal and neonatal morbidity and mortality worldwide, particularly in low- and middle-income countries. Preventing the onset of preeclampsia through population-level strategies such as promoting awareness of healthy gestational weight gain, improving access to nutrition education, and supporting maternal wellness programs can lead to substantial public health gains. Community health workers, midwives, and prenatal educators should be equipped with the knowledge and tools to monitor and guide weight management during pregnancy at the grassroots level.

Furthermore, public health policies could be refined to emphasize early antenatal care visits, where education and risk screening can be conducted comprehensively. Campaigns that address healthy eating habits, obesity prevention, and the importance of regular antenatal checkups are crucial, particularly in regions where maternal health services are underutilized or access is limited(Hanson et al., 2017). Such interventions not only reduce the burden of preeclampsia but also contribute to lowering healthcare costs and improving the overall quality of maternal and neonatal care.

The relationship between early pregnancy weight gain and the risk of preeclampsia underscores the need for an integrated clinical and public health response(Ilekis et al., 2007). By applying the insights from this research in clinical settings and embedding them into maternal health policy frameworks, we can significantly improve pregnancy outcomes and advance maternal health equity across diverse populations.

4. CONCLUSION

This research highlights the significant association between maternal weight gain in the first and second trimesters and the risk of developing preeclampsia in the third trimester. The findings suggest that excessive or rapid weight gain during early pregnancy particularly beyond the thresholds recommended by health authorities such as the Institute of Medicine (IOM) can serve as an early warning sign for preeclampsia. These patterns reflect underlying physiological changes such as metabolic dysfunction and inflammation, which are known contributors to the development of

hypertensive disorders in pregnancy. By identifying trimester-specific weight gain as a modifiable and measurable risk factor, this study emphasizes the importance of early and continuous prenatal monitoring. Clinicians can use this information to stratify risk, implement early lifestyle interventions, and provide closer surveillance for women who show abnormal weight gain trajectories. Additionally, public health initiatives that promote maternal nutrition awareness, early antenatal care, and community-based support systems are essential to reduce the overall incidence of preeclampsia, especially in resource-limited settings. Ultimately, the integration of weight gain monitoring into standard prenatal care protocols holds great potential to improve maternal and fetal outcomes. Future research is encouraged to further explore this relationship across diverse populations and to develop predictive models that combine weight gain patterns with other clinical indicators to enhance early detection and prevention strategies for preeclampsia.

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