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ORIGINAL ARTICLE

Comparison of Pre Pregnancy BMI and Trimester Specific Weight Gain on Fetomaternal Outcome

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ABSTRACT

Background: Pregnancy BMI and trimester-specific weight increase are two indicators of maternal weight, which is important in determining the health outcomes for both the mother and the fetus.

Objective: This study aim was to compare the effects of pre-pregnancy BMI and trimester-specific weight gain on fetomaternal outcomes, providing a more comprehensive understanding of their combined impact on maternal and neonatal health.

Methodology: A prospective observational study was conducted at Combined Military Hospital, Malir Cantonment, from April to December 2023. Using certain inclusion and exclusion criteria, 135 pregnant women with singleton pregnancies were included. Antenatal data was used to gather maternal characteristics, such as pre-pregnancy BMI, weight increase by trimester, and obstetric history. At delivery, fetomaternal outcomes were recorded. SPSS version 26 was used for the statistical analysis, and the chi-square and t-tests were used for the continuous and categorical variables, respectively.

Results: The research included 135 pregnant women with a total gestational weight increase of 10.1 ± 3.2 kg and a mean pre-pregnancy BMI of 24.8 ± 3.9 kg/m². Overweight (40%) and obese (44.44%) women had substantially higher cesarean section rates than normal-weight (23.61%) and underweight (20%) women ($p = 0.021$). Compared to normal-weight (8.33%) and overweight (13.33%) groups, underweight (26.67%) and obese (22.22%) groups had higher rates of preterm birth ($p = 0.045$). Macrosomia (>4.0 kg) was more common in overweight (13.33%) and obese (11.11%) women ($p = 0.027$), while low birth weight (<2.5 kg) was most common in underweight women (40%) ($p = 0.032$). Overweight women had the highest prevalence of gestational hypertension (20%) ($p = 0.018$). Neonatal outcomes were strongly impacted by trimester-specific weight increase, with macrosomia ($p = 0.031$) being related with excessive weight growth and low birth weight ($p = 0.012$) with insufficient weight gain.

Conclusion: Pre-pregnancy BMI and trimester-specific weight gain significantly influence fetomaternal outcomes, emphasizing the importance of optimal weight management during pregnancy to reduce adverse complications.

Keywords: Pre-pregnancy BMI, trimester-specific weight gain, fetomaternal outcomes, cesarean section, preterm birth, gestational hypertension.

INTRODUCTION

Pregnancy-related weight control and maternal nutrition are important factors that affect the health of the mother and fetus[1,2]. Two important factors that affect the likelihood of problems such as gestational diabetes, preeclampsia, preterm delivery, and fetal development anomalies are pre-pregnancy body mass index (BMI) and gestational weight gain (GWG)[3]. Understanding the effects of pre-pregnancy BMI and trimester-specific weight increase on fetomaternal outcomes has become a critical public health issue due to the rising incidence of obesity and undernutrition globally[4,5].

Pregnancy-related hazards have been linked to pre-pregnancy body mass index (BMI), which is a baseline measure of maternal nutritional health[6]. While women with a low BMI are more likely to have intrauterine growth restriction (IUGR) and preterm labor, those with a high BMI before to conception are more likely to experience gestational hypertension, cesarean birth, and macrosomia[7]. Pregnancy outcomes are also significantly impacted by prenatal weight increase, especially in various trimesters[8]. While insufficient weight increase may result in small-for-gestational-age (SGA) newborns and neonatal morbidity, excessive weight gain can cause large-for-gestational-age (LGA) infants and delivery problems[9]. Even while there are standards that suggest ideal weight growth ranges based on pre-pregnancy BMI, there is still variable adherence to these recommendations, which often has negative effects on both the mother and the newborn[10,11].

The impacts of pre-pregnancy BMI and total gestational weight growth have been well studied in previous research; however, little is known about the ways in which weight gain throughout certain trimesters interacts with pre-pregnancy BMI to affect fetomaternal outcomes. The weight increase distribution by trimester may provide more detailed information about crucial times that influence pregnancy difficulties and the health of the newborn. Gaining insight into these connections may help improve therapeutic therapies, weight-management techniques, and dietary advice for expectant mothers.

Research Objective: This study aims were to compare the effects of pre-pregnancy BMI and trimester-specific weight gain on fetomaternal outcomes, providing a more comprehensive understanding of their combined impact on maternal and neonatal health.

METHODOLOGY

Study Design and Setting: This was a prospective cohort study conducted at the Department of Obstetrics and Gynaecology, Combined Military Hospital, Malir Cantonment. The study was carried out over a period of nine months, from April 4, 2023, to December 31, 2023.

Inclusion and Exclusion Criteria: Participants were pregnant women with a documented pre-pregnancy BMI, a confirmed singleton pregnancy of 10 weeks' gestation which was followed till term with regular prenatal check-ups with weight increase recorded each trimester. The research excluded women with known fetal abnormalities, insufficient prenatal records, multiple pregnancies, loss to follow-up, or pre-existing medical illnesses including diabetes, hypertension, or thyroid disorders.

Sample Size: Convenience sampling was used to recruit 135 pregnant women who met the study's inclusion criteria. Participants were chosen based on their availability and willingness to participate.

Data Collection: Antenatal records were used to gather maternal data, such as pre-pregnancy BMI, gestational weight increase each trimester, and obstetric history. A calibrated weighing scale was used to assess weight at the start of pregnancy and at the conclusion of each trimester. At delivery, fetomaternal outcomes were recorded, such as the delivery method, birth weight, Apgar scores, and maternal complications. Validated medical records and organized proformas were used to gather data.

Statistical Analysis: SPSS version 26 was used to analyze the data. Maternal and newborn characteristics were summarized using descriptive statistics. The chi-square test was used to evaluate categorical data, while independent t-tests were used to compare continuous variables. Statistical significance was defined as a p-value of less than 0.05.

Ethical Approval: The research received ethical clearance from the institutional ethics review committee. Prior to registration, all participants gave their informed permission, guaranteeing anonymity and the freedom to leave the research at any time.

RESULTS

The research participants' maternal characteristics are shown in Table 1. Their mean age was 28.4 ± 4.2 years, and their pre-pregnancy BMI was 24.8 ± 3.9 kg/m². Of the individuals, 13.33% were obese (≥30), 22.22% were overweight (25–29.9), 53.33% were normal weight, and 11.11% were underweight (<18.5). The average gestational weight gain was 10.1 ± 3.2 kg, with mean weight increases of 0.8 ± 1.2 kg in trimester 1, 4.2 ± 1.5 kg in trimester 2, and 5.1 ± 1.7 kg in trimester 3.

Table 1: Maternal Characteristics of Participants

Characteristic	Mean ± SD / n (%)
Age (years)	28.4 ± 4.2
Pre-pregnancy BMI (kg/m²)	24.8 ± 3.9
Underweight (<18.5)	15 (11.11%)
Normal weight (18.5–24.9)	72 (53.33%)
Overweight (25–29.9)	30 (22.22%)
Obese (≥30)	18 (13.33%)
Trimester 1 Weight Gain (kg)	0.8 ± 1.2
Trimester 2 Weight Gain (kg)	4.2 ± 1.5
Trimester 3 Weight Gain (kg)	5.1 ± 1.7
Total Gestational Weight Gain (kg)	10.1 ± 3.2

According to the study's birth outcomes, 7.41% of women needed assisted vaginal delivery using forceps or vacuum, whereas the majority of women (62.96%) had spontaneous vaginal deliveries (table 2). In 29.63% of instances, cesarean sections were carried out. Thirteen percent of births were preterm (before 37 weeks), while eighty-six percent were full-term (37 weeks or after).

Table 2: Distribution of Delivery Methods and Preterm Birth Rates

Parameter	n (%)
Spontaneous Vaginal Delivery (SVD)	85 (62.96)
Assisted Vaginal Delivery (Forceps/Vacuum)	10 (7.41)
Cesarean Section	40 (29.63)
Preterm Delivery (<37 weeks)	18 (13.33)
Term Delivery (≥37 weeks)	117 (86.67)

The research participants' prenatal outcomes are shown in Table 3. The mean birth weight was 3.0 ± 0.5 kg, whereas 14.81% of infants were under 2.5 kg, 77.78% were between 2.5 and 4.0 kg, and 7.41% were classified as macrosomia (above 4.0 kg). In terms of Apgar scores, 3.70% of newborns had a score below 7 at 5 minutes, compared to 8.89% at 1 minute. Furthermore, 7.41% of the newborns needed to be admitted to the neonatal intensive care unit.

Table 3: Fetal Outcomes

Parameter	Mean ± SD / n (%)
Birth Weight (kg)	3.0 ± 0.5
Low Birth Weight (<2.5 kg)	20 (14.81%)
Normal Birth Weight (2.5–4.0 kg)	105 (77.78%)
Macrosomia (>4.0 kg)	10 (7.41%)
Apgar Score <7 at 1 min	12 (8.89%)
Apgar Score <7 at 5 min	5 (3.70%)
Neonatal ICU Admission	10 (7.41%)

The participants' experiences with maternal problems are shown in Figure 1. Of the women, 8.89% developed gestational diabetes and 11.11% had gestational hypertension. 5.93% had preeclampsia, and 7.41% suffered from postpartum hemorrhage (PPH). In 10.37% of instances, preterm labor was seen. Most participants (56.30%) had no pregnancy difficulties.

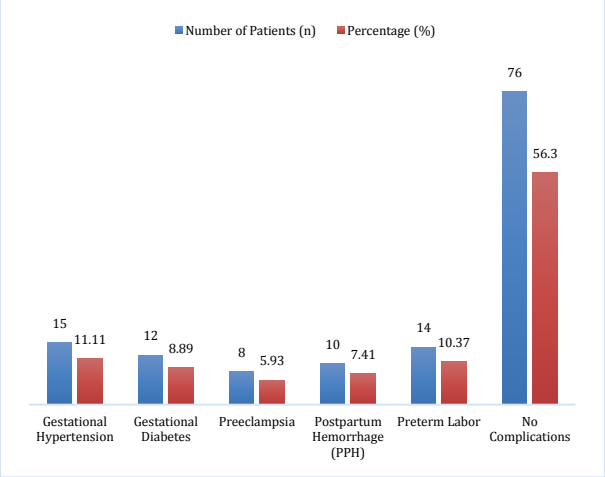

Figure 1: Maternal Complications

Fetomaternal outcomes are compared by pre-pregnancy BMI groups in Table 5. With a significant p-value of 0.021, the rates of cesarean sections were 20.00% for underweight women, 23.61% for normal women, 40.00% for overweight women, and 44.44% for obese women. With a p-value of 0.045, preterm birth was more likely in underweight (26.67%) and obese (22.22%) women than in normal (8.33%) and overweight (13.33%) women. With a p-value of 0.032, the incidence of low birth weight was greatest among underweight mothers (40.00%), followed by normal weight (11.11%), overweight (13.33%), and obese women (11.11%). With a p-value of 0.027, macrosomia was found in 5.56% of women of normal weight, 13.33% of women who were overweight, and 11.11% of women who were obese. No instances were found in women who were underweight. Finally, with a p-value of 0.018, the prevalence of gestational hypertension was highest among overweight women (20.00%).

Table 5: Comparison of Maternal Outcomes by Pre-pregnancy BMI & trimester specific weightgain Categories

Outcome	Underweight	Normal	Overweight	Obese	p-value
Cesarean Section (n;%)	3 (20.00%)	17 (23.61%)	12 (40.00%)	8 (44.44%)	0.021*
Preterm Birth (n;%)	4 (26.67%)	6 (8.33%)	4 (13.33%)	4 (22.22%)	0.045*
Low Birth Weight (<2.5 kg) (n;%)	6 (40.00%)	8 (11.11%)	4 (13.33%)	2 (11.11%)	0.032*
Macrosomia (>4.0 kg) (n;%)	0 (0.00%)	4 (5.56%)	4 (13.33%)	2 (11.11%)	0.027*
Gestational Hypertension/Preeclampsia (n;%)	2 (20.00%)	5 (6.94%)	6 (20.00%)	2 (11.11%)	0.018*

Table 6: Comparison of Fetal Outcomes by Trimester-Specific Weight Gain

Outcome	Inadequate Weight Gain	Adequate Weight Gain	Excessive Weight Gain	p-value
Low Birth Weight (<2.5 kg)	12	6	2	0.012*
Macrosomia (>4.0 kg)	1	5	4	0.031*
Neonatal ICU Admission	5	1	4	0.145

The comparison of fetomaternal outcomes according to trimester-specific weight growth is shown in Table 6. In comparison to the appropriate (6 instances) and excessive weight growth (2 cases), low birth weight (<2.5 kg) was more prevalent in the inadequate weight increase group (12 cases), with a statistically significant correlation (p = 0.012). One instance of insufficient weight increase, five cases of appropriate weight gain, and four cases of excessive weight gain all had macrosomia (>4.0 kg), which was statistically significant (p = 0.031). Five instances of insufficient weight growth, one case of appropriate weight gain, and four cases of excessive weight increase were associated with neonatal intensive care unit hospitalization; however, the correlation was not statistically significant (p = 0.145).

DISCUSSION

The comparison of fetomaternal outcomes according to pre-pregnancy BMI in this research showed noteworthy correlations with important pregnancy problems. In contrast to the 20% in the underweight group and the 23.61% in the normal-weight group, our results showed that 40% of overweight women and 44.44% of obese women had cesarean sections (p-value = 0.021). This is in line with other research that showed that problems such shoulder dystocia and fetal macrosomia put women who are overweight or obese at higher risk of cesarean birth[12]. The higher prevalence of cesarean sections among our study's overweight and obese groups emphasizes the need of focused measures to control weight increase throughout pregnancy in order to lower the number of cesarean deliveries.

According to our research, the risk of preterm birth was lowest among normal-weight women (8.33%), followed by obese women (22.22%) and underweight women (26.67%) (p-value = 0.045). These findings are consistent with other studies that found obesity and underweight to be risk factors for preterm birth, most likely because of placental insufficiency and hormonal imbalance in these populations[13]. In addition, a research by Girsen et al. (2016) found that women who were underweight or obese had a greater risk of preterm delivery than women with a normal BMI, indicating that maternal weight plays a critical role in controlling the length of pregnancy[14].

Women who were underweight had the highest prevalence of low birth weight (<2.5 kg) at 40%, followed by those who were normal weight (11.11%) and overweight/obese (both 11.11%) (p-value = 0.032). This result is in line with earlier research that showed underweight to be a substantial risk factor for low birth weight and intrauterine growth restriction (IUGR)[15]. Our study's increased rate of low birth weight among underweight women is consistent with results from earlier research, which indicates that early pregnancy nutritional deficiencies in mothers may lead to insufficient fetal development[16]. With a p-value of 0.027, macrosomia (>4.0 kg) was more common in overweight (13.33%) and obese (11.11%) women than in underweight women (0%). This finding supports previous research that shows maternal obesity increases the likelihood of giving birth to children with macrosomia, most likely as a consequence of maternal insulin resistance and hyperglycemia[17].

Lastly, our research showed that there were low incidences (n=2) of gestational hypertension in underweight women (p-value = 0.018), with the highest prevalence's occurring in overweight women (20.00%). This result is consistent with other studies that clearly linked maternal obesity to a higher risk of hypertensive conditions during pregnancy, including preeclampsia and gestational hypertension[18]. Obesity is a significant predictor of gestational hypertension, according to a review research by Skrypnik et al. (2019), and women who are overweight are at a comparable increased risk as those with a normal BMI[19]. Our results demonstrate how important it is to track and control a mother's weight both before and throughout pregnancy in order to reduce the risk of hypertensive problems.

Study Strength and Limitations: This research adds to the increasing amount of data showing the significance of maternal weight control by offering insightful information on the connection between pre-pregnancy BMI, trimester-specific weight increase, and fetomaternal outcomes. This study's prospective design is one of its strong points as it enables reliable monitoring of mother weight and pregnancy outcomes as well as real-time data collection. Furthermore, a broad variety of pregnancy problems could be examined since the research comprised a diversified sample of women from various BMI categories. There are a few restrictions, however. First, convenience sampling may create selection bias, and the 135 participant sample size may restrict how far the results may be applied. Furthermore, other confounding variables that may affect pregnancy outcomes, such as dietary habits, physical activity, and socioeconomic status, were not taken into consideration in this research. Finally, the findings' external validity may be impacted by the study's single-center design, which may not represent the experiences of women from other geographic locations or healthcare settings. Notwithstanding these drawbacks, the research offers useful data to help medical professionals comprehend how maternal weight affects pregnancy outcomes.

CONCLUSION

This research emphasizes how pre-pregnancy BMI and weight gain each trimester has a substantial effect on fetomaternal outcomes. These characteristics also influence major pregnancy issues such as the frequencies of cesarean sections, premature delivery, low birth weight, macrosomia, and gestational hypertension.The results highlight how crucial it is to control weight properly both before and throughout pregnancy in order to maximize the health of both the mother and the fetus. Our findings are consistent with other studies that highlight the importance of maternal weight and nutrition in influencing pregnancy outcomes, offering important information for clinical practice and public health initiatives targeted at enhancing pregnancy outcomes via improved weight management techniques. To support these results and investigate the long-term impacts of maternal weight on the health of both mothers and children, additional research with bigger and more varied sample sizes is required.

REFERENCES

1. Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, Friedman JE, Hay Jr WW, Hernandez TL, Krebs NF, Oken E, Purnell JQ. The importance of nutrition in pregnancy and lactation: lifelong consequences. American journal of obstetrics and gynecology. 2022 May 1;226(5):607-32. https://doi.org/10.1016/j.ajog.2021.12.035
2. Monfared Z. The Importance of Nutrition for Fetal Health. Japanese Journal of Medical Science. 2023 Jun 5;2(1):1-8. DOI: 10.33140/JJMS
3. Lewandowska M, Więckowska B, Sajdak S. Pre-pregnancy obesity, excessive gestational weight gain, and the risk of pregnancy-induced hypertension and gestational diabetes mellitus. Journal of clinical medicine. 2020 Jun 24;9(6):1980. https://doi.org/10.3390/jcm9061980
4. Catalano PM, Shankar K. Obesity and pregnancy: mechanisms of short term and long term adverse consequences for mother and child. Bmj. 2017 Feb 8;356. doi: https://doi.org/10.1136/bmj.j1
5. McGillick EV, Lock MC, Orgeig S, Morrison JL. Maternal obesity mediated predisposition to respiratory complications at birth and in later life: understanding the implications of the obesogenic intrauterine environment. Paediatric respiratory reviews. 2017 Jan 1;21:11-8. https://doi.org/10.1016/j.prrv.2016.10.003.
6. Bhowmik, B., Siddique, T., Majumder, A. et al. Maternal BMI and nutritional status in early pregnancy and its impact on neonatal outcomes at birth in Bangladesh. BMC Pregnancy Childbirth 19, 413 (2019). https://doi.org/10.1186/s12884-019-2571-5
7. Breckenkamp J, Razum O, Henrich W, Borde T, David M. Effects of maternal obesity, excessive gestational weight gain and fetal macrosomia on the frequency of cesarean deliveries among migrant and non-migrant women–a prospective study. Journal of perinatal medicine. 2019 May 27;47(4):402-8. https://doi.org/10.1515/jpm-2018-0399.

8. Drehmer M, Duncan BB, Kac G, Schmidt MI. Association of second and third trimester weight gain in pregnancy with maternal and fetal outcomes. PloS one. 2013 Jan 30;8(1):e54704. https://doi.org/10.1371/journal.pone.0054704
9. Stotland NE, Cheng YW, Hopkins LM, Caughey AB. Gestational weight gain and adverse neonatal outcome among term infants. Obstetrics & Gynecology. 2006 Sep 1;108(3 Part 1):635-43. DOI: 10.1097/01.AOG.0000228960.16678.bd.
10. Elliott-Sale KJ, Graham A, Hanley SJ, Blumenthal S, Sale C. Modern dietary guidelines for healthy pregnancy; maximising maternal and foetal outcomes and limiting excessive gestational weight gain. European journal of sport science. 2019 Jan 2;19(1):62-70. https://doi.org/10.1080/17461391.2018.1476591.
11. 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. Journal of Human Nutrition and Dietetics. 2022 Apr;35(2):250-64. https://doi.org/10.1111/jhn.12999.
12. Wispelwey BP, Sheiner E. Cesarean delivery in obese women: a comprehensive review. The Journal of Maternal-Fetal & Neonatal Medicine. 2013 Apr 1;26(6):547-51. https://doi.org/10.3109/14767058.2012.745506.
13. Scott, H., Grynspan, D., Anderson, L.N. et al. Maternal Underweight and Obesity Are Associated with Placental Pathologies in Human Pregnancy. Reprod. Sci. 29, 3425–3448 (2022). https://doi.org/10.1007/s43032-022-00983-2
14. Girsen AI, Mayo JA, Carmichael SL, Phibbs CS, Shachar BZ, Stevenson DK, Lyell DJ, Shaw GM, Gould JB, March of Dimes Prematurity Research Center at Stanford University School of Medicine. Women's prepregnancy underweight as a risk factor for preterm birth: a retrospective study. BJOG: An International Journal of Obstetrics & Gynaecology. 2016 Nov;123(12):2001-7. https://doi.org/10.1111/1471-0528.14027.
15. Montvignier Monnet A, Savoy D, Préaubert L, Hoffmann P, Bétry C. In underweight women, Insufficient Gestational Weight Gain is Associated with adverse obstetric outcomes. Nutrients. 2022 Dec 23;15(1):57. https://doi.org/10.3390/nu15010057.
16. King JC. The risk of maternal nutritional depletion and poor outcomes increases in early or closely spaced pregnancies. The Journal of nutrition. 2003 May 1;133(5):1732S-6S. https://doi.org/10.1093/jn/133.5.1732S.
17. Salihu HM, Weldeselasse HE, Rao K, Marty PJ, Whiteman VE. The impact of obesity on maternal morbidity and feto-infant outcomes among macrosomic infants. The Journal of Maternal-Fetal & Neonatal Medicine. 2011 Sep 1;24(9):1088-94. https://doi.org/10.3109/14767058.2010.546451
18. Madan J, Chen M, Goodman E, Davis J, Allan W, Dammann O. Maternal obesity, gestational hypertension, and preterm delivery. The Journal of Maternal-Fetal & Neonatal Medicine. 2010 Jan 1;23(1):82-8. https://doi.org/10.3109/14767050903258738
19. Skrypnik D, Bogdański P, Zawiejska A, Wender-Ożegowska E. Role of gestational weight gain, gestational diabetes, breastfeeding, and hypertension in mother-to-child obesity transmission. Pol Arch Intern Med. 2019 Apr 30;129(4):267-75. doi:10.20452/pamw.4482.

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