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"Assessment of early pregnancy BMI; gestational weight gain in association with neonatal birthweight- An observational study."

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ABSTRACT

Health of the mother is crucial for baby's growth. Body Mass Index (BMI) is a common measure to assess mother's nourishment. Existing research suggests that undernourished mother can negatively impact the development of the placenta, which in turn affects blood flow and size. This can affect neonatal weight gain. However, there is a gap in the existing literature when it comes to linking the mother's BMI with the weight of the newborn. Hence the aim of the study is to assess the impact of early pregnancy BMI and gestational weight gain on neonatal birth weight.

OBJECTIVES - Assess the association between Early pregnancy BMI and gestational weight gain on neonatal birth weight.

MATERIAL and METHODS - An observational study was conducted at Dr D Y Patil Medical College & Hospital, Pimpri, Pune, involving 500 pregnant women with uncomplicated singleton pregnancies. All Ethical procedure was followed, and participants were recruited based on previous study data. Exclusions were made for systemic diseases. Pre-conceptional weight, height, weight gain during pregnancy, gestational age at delivery, and neonatal birth weight were recorded. Statistical analysis was performed.

RESULTS– The study of 500 pregnant women found varied BMI distribution, with 55.7% normal, 18% underweight, and 18% overweight. Gestational weight gain and last trimester BMI changes were observed. Maternal BMI correlated with neonatal birth weight. Regional variations in neonatal birth weight were noted, prompting further research on low birth weight risks in underweight and obese females. Limitations include observer bias and a single-location study.

CONCLUSION- Low BMI (underweight) and high BMI (obese) both contribute to low newborn birth weight. Gestational weight gain (GWG) is a crucial predictor of neonatal birth weight. Assessing GWGs is vital for implementing preventive measures against the risk of low birth weight.

Keyword- Birth weight, Body mass index, Gestation, Low birth weight, Newborn, Weight gain,

➢ INTRODUCTION:

Pregnancy is like a journey where many things can affect the destination. The factors, such as the different paths we take, can greatly influence the result. It's a blend of what we inherit and how we live, of luck and decisions. These elements work together, like pieces of a puzzle, to shape the outcome of a pregnancy. Prominent among these are the mother's Body Mass Index (BMI) at the onset of pregnancy and her weight gain (GWG) during the gestational period (1), both of these factors hold substantial influence over the progression and results of the pregnancy. Maternal health refers to the health of women during pregnancy, childbirth and the postnatal period. Each stage should be positive to help women and their babies reach their health and well-being potential (2). Ultimately, the neonate's birth weight reflects the numerous prenatal circumstances and affects the child's quality of life, growth, and development, as well as childhood morbidity and mortality. Pregnancy outcomes are significantly influenced by the early pregnancy body mass index (BMI) and gestational weight gain (GWG) of the mother (3). Adequate intake of macronutrients and micronutrients during pregnancy promotes these processes, while undernutrition and overnutrition can be associated with adverse pregnancy outcome (4). The issue of nutritional deficiencies during pregnancy continues to be a matter of public health importance, as both undernutrition and overnutrition have been linked to negative outcomes in pregnancy (5).

As per the definition provided by the World Health Organisation (WHO), low birth weight is characterised by an infant weighing below 2500 g (5.5 lb) at the time of delivery. The category of low birth weight encompasses preterm neonates, small for gestational-age neonates born at term, as well as the co-occurrence of these two conditions. This specific group of infants is known to experience particularly adverse perinatal outcomes (6). Globally, it is estimated that approximately 15% to 20% of all births result in low birth weight, amounting to over 20 million births annually (7). There exists a correlation between low birth weight and a variety of short-term and long-term consequences, including prematurity. Annually, approximately 1.1 million infants succumb to complications arising from premature birth. Neonates with low birth weight face a significantly higher mortality risk, exceeding 20 times the risk faced by neonates with a birth weight exceeding 2500 g (8). Individuals who manage to survive often experience persistent undernourishment, accompanied by diminished muscle strength and growth, as well as compromised immune function, thereby increasing their susceptibility to various diseases. Infants with low birth weight are not only highly susceptible to mortality but also face an elevated likelihood of enduring long-term neurological impairment, compromised language acquisition, diminished cognitive capacities and intelligence quotient, as well as an augmented vulnerability to medical conditions such as cardiovascular disease and diabetes in their later years(7). Moreover, as a result of the incomplete development of various organ systems, there exists a significant susceptibility to respiratory distress, interventricular haemorrhage, sepsis, visual impairment, and gastrointestinal disorders (9). World Health Organization set a target in 2012 to achieve a 30% reduction in the number of low birth weight babies by 2025 (10).

Healthy mothers deliver healthy babies, Infants born to mothers who experience

malnourishment, poor health, or insufficient prenatal and delivery care are at an elevated susceptibility to disease and premature mortality (11)**.** BMI is a globally accepted method to assess maternal nutritional status. It is calculated as weight in kilogram divided by the squareof height in meters (Wt in (kg) / Ht in $(m)^2$) (1). Data from human epidemiologic research indicate that maternal undernutrition affects placental development, resulting in changes to histomorphology, a reduction in blood flow, and a reduction in placental size, which can reduce food delivery to the fetus (12). The Neonatal birth weight is an essential marker for neonatal and infant health, with both low and high birth weight linked to increased health risks (13). Consequently, understanding the relationship between early pregnancy BMI, GWG, and neonatal birth weight is critical for developing effective public health strategies to improve pregnancy outcomes and infant health.

Pregnancy complications exhibit a higher prevalence at both the higher and lower ends of the weight spectrum. Moreover, an excessive amount of gestational weight gain (GWG) has the potential to increase the likelihood of childhood obesity and the retention of postpartum weight in mothers. Excessive gestational weight gain (GWG) during the initial pregnancy is indicative of a heightened likelihood of experiencing excessive weight gain in subsequent pregnancies (14). The mentioned concern is further compounded by the observation that women tend to experience weight gain between pregnancies rather than weight loss. This increase in weight is associated with an elevated likelihood of developing various conditions, including gestational diabetes mellitus, pregnancy-induced hypertension, caesarean delivery, preterm birth, large for gestational age (LGA), stillbirth, and cleft palate (15).

There exists a significant gap in applying the updated guidelines of the Institute of Medicine (IOM) concerning gestational weight gain (GWG) to the Indian population. Additionally, these IOM GWG guidelines require validation across different demographics. This research seeks to explore the relationship between early pregnancy BMI and GWG relative to neonatal birth weight. By investigating this association, the study aims to enhance the current understanding in this area, potentially aiding in refining the guidelines for managing maternal weight during pregnancy on neonatal birth weight. Hence the present study was conducted with the aim, "to Assess the impact of early pregnancy BMI on neonatalbirth weight." And objectives of the study were 1) To assess the Early Pregnancy BMI in pregnant women. 2) To Assess the Association between Early pregnancy BMI & neonatal birth weight.

- **MATERIAL AND METHODOLOGY:** An Observational Study was conducted in the Department of Pediatrics and Department of Obstetrics & Gynaecology of Dr D Y Patil Medical College & Hospital, Pimpri , Pune. After getting ethical approval from IEC, a written consent was obtained from the participants. Total 500 sample size were obtained by using previous study data. Pregnant women with uncomplicated singleton pregnancies booked for regular antenatal care by 10 weeks of gestation were included in the study. Participants having systematic disease were excluded. The Data of the enrolled participants was collected in the pre-formed proforma. The pre-conceptional weight; height of the participants was recorded. Weight gain during pregnancy was recorded. Information about the gestational age at delivery and the birth weight of the neonates were collected following delivery. All the records was compiled in systematic

manner using Microsoft Excel worksheet (Microsoft, USA, version 8.1).

Statistical Analysis: Statistical analysis using IBM Statistical Package for Social Science (Statistics for Windows, version 21.0, Armonk, NY: IBM Corp.) was done and the comparison of data was carried out by applying statistical tests in order to find the statistical significance of the results.

- **RESULT:** The age of the participants was between 20-38 years. All the participants had received iron-folic acid, inj. TT as antenatal care. Height of the mothers observed were within a range of 140-164 cm. Out of the total 500 participants, periconceptional BMI status observed was as follows- Most of them 55.2% (n=276) had normal BMI score (18-24) next to them nearly 18% (n=89) participants were underweighted with BMI score below 18 and 18.8% (n=91) were overweight with BMI score between 25 to 32. A few, 8.8% (n=44) patients were obese with BMI score more than 33. Average gestational weight gain was calculated - last trimester showed 11.77(±3.97), 10.62(±3.34), 9.49 (±3.52) and 6.84(±2.87) for underweight, normal, overweight and obese participants respectively. Hence number of participants showed a change in their BMI status at the end of last trimester and that were recorded as follows: only 0.6% (n=3) participants remained underweight, 37.8% (n=188) participants had their BMI within normal range. The number of participants who became overweight and obese were 38.8% (n=194) and 23% (n=115) respectively. (Table 1)

  Mothers having pre-conceptional BMI of Underweight, Normal, Overweight and Obese gave birth to babies with average neonatal weight of 2.59 (±0.40), 2.49(±0.42), 2.34 (±0.35) and 2.40(±0.29) Kilograms respectively. Those mothers with last trimester BMI of Underweight, Normal, Overweight and Obese gave birth to babies with average neonatal weight of 1.60(±0.35), 2.70 (±0.32), 2.31(±0.42) and 2.39(±0.32) Kilograms respectively. (Graph 1). Mothers with normal BMI status gave birth to newborn with normal birth weight and those who were underweight and obese gave birth to low birth weight babies.

- **DISCUSSION:** An average neonatal birthweight in India ranges 2.8 to 3.2 kgs. However, in Europe and the United States it is 3.4 – 3.6 kg. In African region it is 3-3.5 Kg. And in low/middle income countries average neonatal birthweight is 2.5-3.5 Kgs. The average weight of the new born babies were found to be normal of those born to mothers with BMI status of normal. And the mothers those who were underweight, overweight and obese gave birth to babies having a low birth weight. Similar trend was found in the study of Hiroyuki Uchinuma *et al* (2021) and Magdalena Nowak *et al* (2019). But the weight of the baby was within different range.This may be due to the average birthweight of the neonates was different for the various geographical location.

  All the measures considered here are for Full term delivered babies. The average weight gain during the gestational period was found to be 11.77 kgs and 10.62 kgs for underweight and normal BMI score mothers and this result was similar that is 10.9 kgs and 10.3 kgs for underweight and normal BMI score mothers in the study conducted by Hiroyuki Uchinuma *et al* (2021). But weight gain was lower in the study conducted by Magdalena Nowak *et al* (2019) and their results was nearly 14 kgs for underweight and normal mothers.

Limitations of the study were, observer Bias and the study is done in a single location, more studies are needed with different locations and different populations for the generalizability of the results. The strength of this study is the adequate sample size. Strong selection criteria to encounter the confounders. Followed all the principles of research methods during study conduction. This study seeks the attention of researchers for future studies to conduct risk of low birth weight of Underweight and Obese females.

- **CONCLUSION:** Low BMI or highest BMI that is underweight, and obese both conditions lead to low birthweight of an infant. Gestational weight gain measure plays an important role in the prediction of neonatal birth weight. Assessment of GWGs is crucial for further therapeutic implementation to prevent the risk of low birth weight.

CONFLICT OF INTEREST: No conflict of interest.

- **REFERENCES:**

1. Mohapatra I, Harshini N, Samantaray SR, Naik G. Association Between Early Pregnancy Body Mass Index and Gestational Weight Gain in Relation to Neonatal Birth Weight. Cureus [Internet]. 2022 Jul 21 [cited 2023 Jul 2]; Available from: https://www.cureus.com/articles/103130-association-between-early-pregnancy-body-mass- index-and-gestational-weight-gain-in-relation-to-neonatal-birth-weight

2. WHO,. Maternal health. 2023 [cited 2023 Aug 4]. Maternal health. Available from:https://www.who.int/health-topics/maternal-health

3. Stang J, Huffman LG. Position of the Academy of Nutrition and Dietetics: Obesity,Reproduction, and Pregnancy Outcomes. Journal of the Academy of Nutrition and Dietetics. 2016 Apr 1;116(4):677–91.

4. BJOG - 2014 - Feodor Nilsson - Risk factors for miscarriage from a prevention perspectivea nationwide follow-up study.pdf.

5. Mousa A, Naqash A, Lim S. Macronutrient and Micronutrient Intake during Pregnancy:An Overview of Recent Evidence. Nutrients. 2019 Feb 20;11(2):443.

6. Coubert F. 30% reduction in low birth weight.

7. Desta M, Tadese M, Kassie B, Gedefaw M. Determinants and adverse perinatal outcomes of low birth weight newborns delivered in Hawassa University Comprehensive SpecializedHospital, Ethiopia: a cohort study. BMC Research Notes. 2019 Mar 4;12(1):118.

8. Badshah S, Mason L, McKelvie K, Payne R, Lisboa PJ. Risk factors for low birthweight inthe public-hospitals at Peshawar, NWFP-Pakistan. BMC Public

Health. 2008 Jun 4;8(1):197.

9. You D, Hug L, Ejdemyr S, Idele P, Hogan D, Mathers C, et al. Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-
based projections to 2030: a systematic analysis by the UN Inter-agency Group for ChildMortality Estimation. The Lancet. 2015 Dec 5;386(10010):2275–86.
10. Nuffield Trust [Internet]. [cited 2023 Aug 5]. Low birth weight. Available rom:https://www.nuffieldtrust.org.uk/resource/low-birth-weight

11. PRB. PRB. [cited 2023 Aug 5]. Healthy Mothers and Healthy Newborns: The VitalLink. Available from: https://www.prb.org/resources/healthy-mothers-and-healthy- newborns-the-vital-link/

12. Belkacemi L, Nelson DM, Desai M, Ross MG. Maternal Undernutrition InfluencesPlacental-Fetal Development1. Biology of Reproduction. 2010 Sep 1;83(3):325–31.

13. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes ofpreterm birth. Lancet. 2008 Jan 5;371(9606):75–84.

14. Chin JR, Krause KM, Østbye T, Chowdhury N, Lovelady CA, Swamy GK. Gestational weight gain in consecutive pregnancies. American Journal of Obstetrics andGynecology. 2010 Sep 1;203(3):279.e1-279.e6.

15. Poston L, Caleyachetty R, Cnattingius S, Corvalán C, Uauy R, Herring S, et al. Preconceptional and maternal obesity: epidemiology and health consequences. The LancetDiabetes & Endocrinology. 2016 Dec 1;4(12):1025–36.

16. Castillo H, Santos IS, Matijasevich A. Maternal pre-pregnancy BMI, gestationalweight gain and breastfeeding. Eur J Clin Nutr. 2016 Apr;70(4):431–6.

17. Subhan FB, Colman I, McCargar L, Bell RC, The APrON Study Team. Higher Pre- pregnancy BMI and Excessive Gestational Weight Gain are Risk Factors for Rapid WeightGain in Infants. Matern Child Health J. 2017 Jun 1;21(6):1396–407.

18. Chiavaroli V, Hopkins SA, Biggs JB, Rodrigues RO, Seneviratne SN, Baldi JC, et al.The associations between maternal BMI and gestational weight gain and health outcomes in offspring at age 1 and 7 years. Sci Rep. 2021 Oct 21;11(1):20865.

19. Xie J, Han Y, Peng L, Zhang J, Gong X, Du Y, et al. BMI growth trajectory frombirth to 5 years and its sex-specific association with prepregnant BMI and gestational weight gain. Front Nutr. 2023;10:1101158.
20. Cantoral A, Ramírez-Silva I, Lamadrid-Figueroa H, Christensen DL, Bygbjerg IC, Groth-Grunnet L, et al. Pre-pregnancy body mass index and gestational weight-gain predict maternal hemoglobin levels and are jointly associated with neonatal outcomes in aMexican birth cohort. Nutr Hosp [Internet]. 2022 [cited 2023 Aug 5]; Available from: https://www.nutricionhospitalaria.org/articles/03999/show
21.

FIGURES AND GRAPHS:

	Variables	Underweight	Normal	Overweight	Obese
Pre-conceptional	**Number of Participants (n)%**	89 (17.8%)	276(±55.2)	91(±18.8)	44(±8.8)
	mean and SD of neonatal birth weight (Kg)	2.59 (±0.40)	2.49 (±0.42)	2.34 (±0.35)	2.40 (±0.29)
	Minimum Value	1.40	1.50	1.50	1.50
	maximum Value	3.20	3.90	3.10	2.70
Gestational Weight gain (Kg)		**11.77(±3.97)**	**10.62(±3.34)**	**9.49 (±3.52)**	**6.84(±2.87)**
Last 3rd Trimester	**Number of Participants (n)%**	3(±0.6)	188(±37.8)	194(±38.8)	115(±23.0)
	mean and SD of neonatal birth weight (Kg)	1.60 (±0.35)	2.70 (±0.32)	2.31 (±0.42)	2.39 (±0.32)
	Minimum Value	1.40	1.75	1.70	1.20
	maximum Value	2	3.75	3.50	2.70

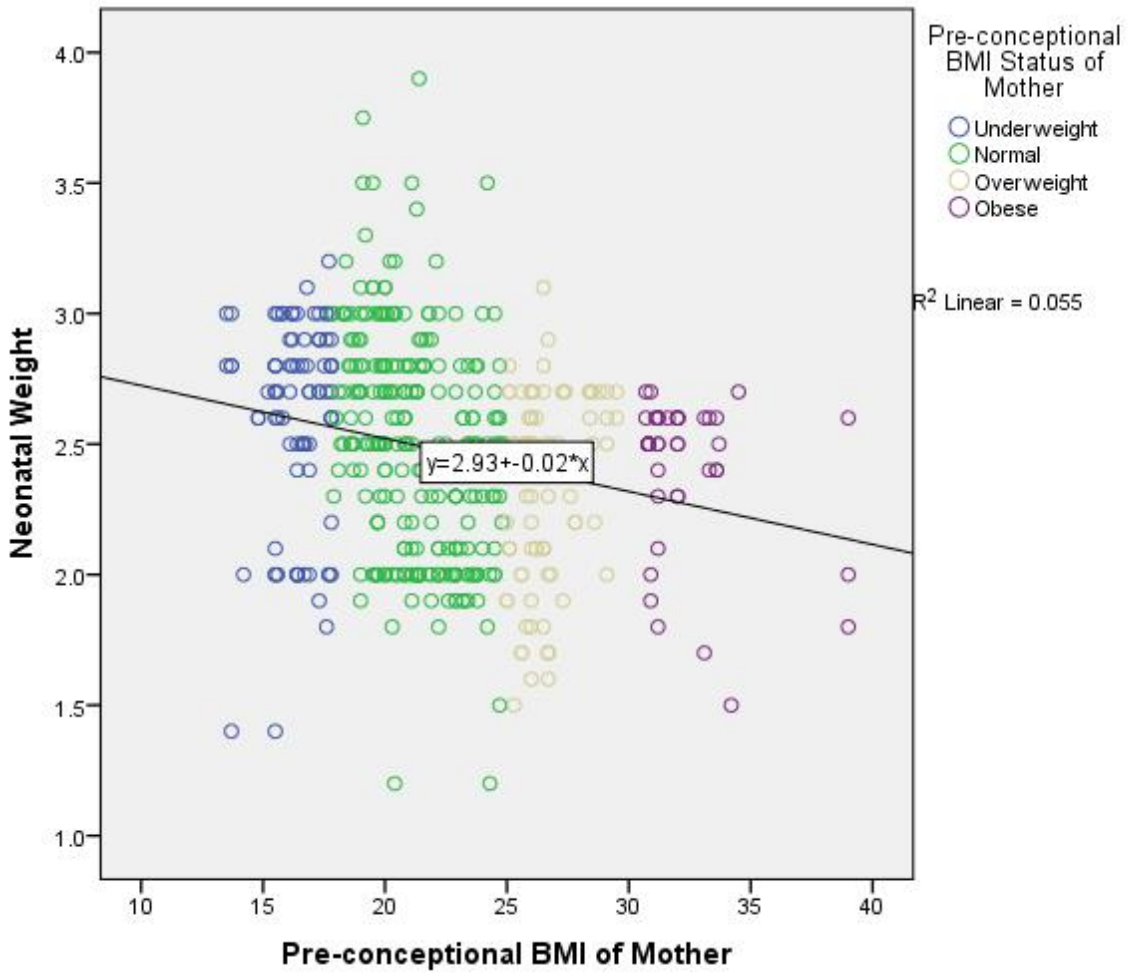

Figure 1 Scatter plot graph for the neonatal birthweight to the pre-conceptional BMI status of respective mothers.

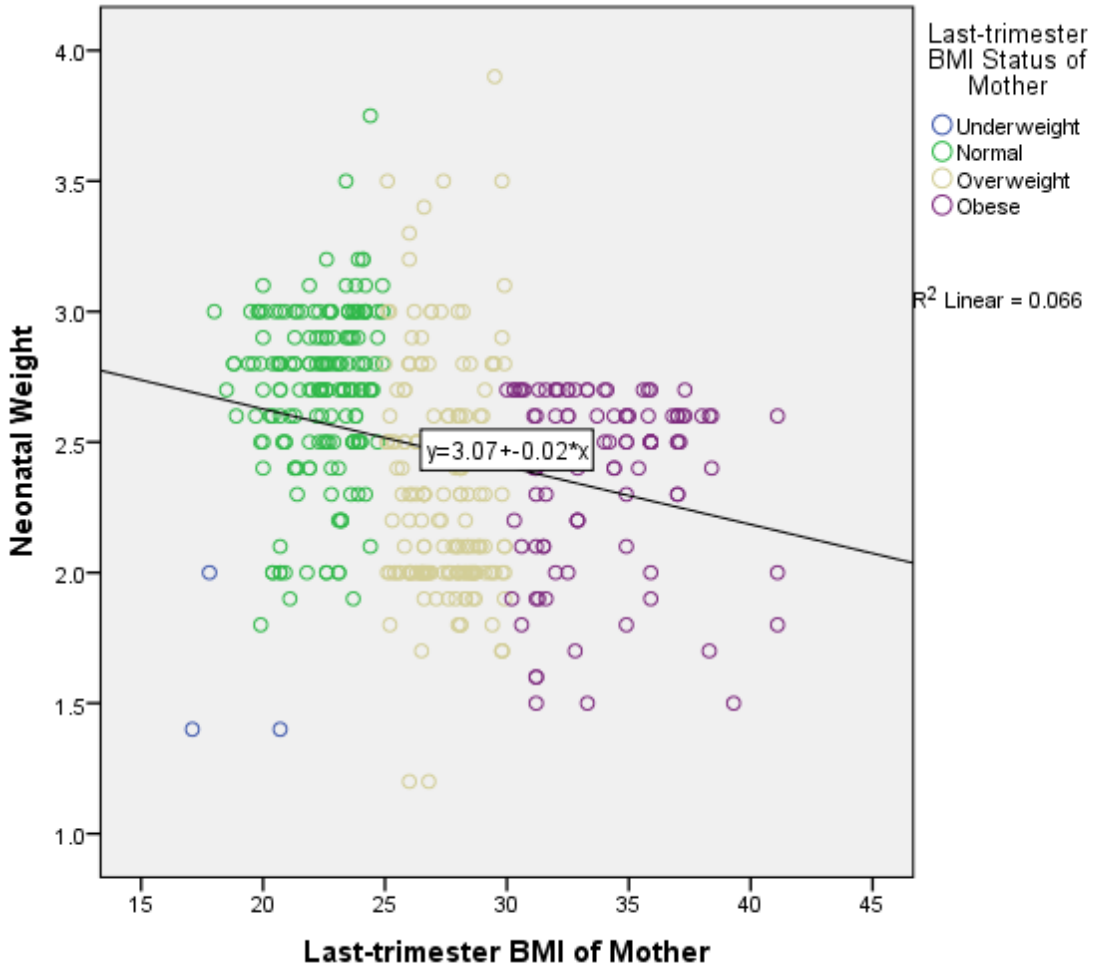

Figure 2 Scatter plot graph for the neonatal birthweight to the last trimester BMI status of respective mothers.

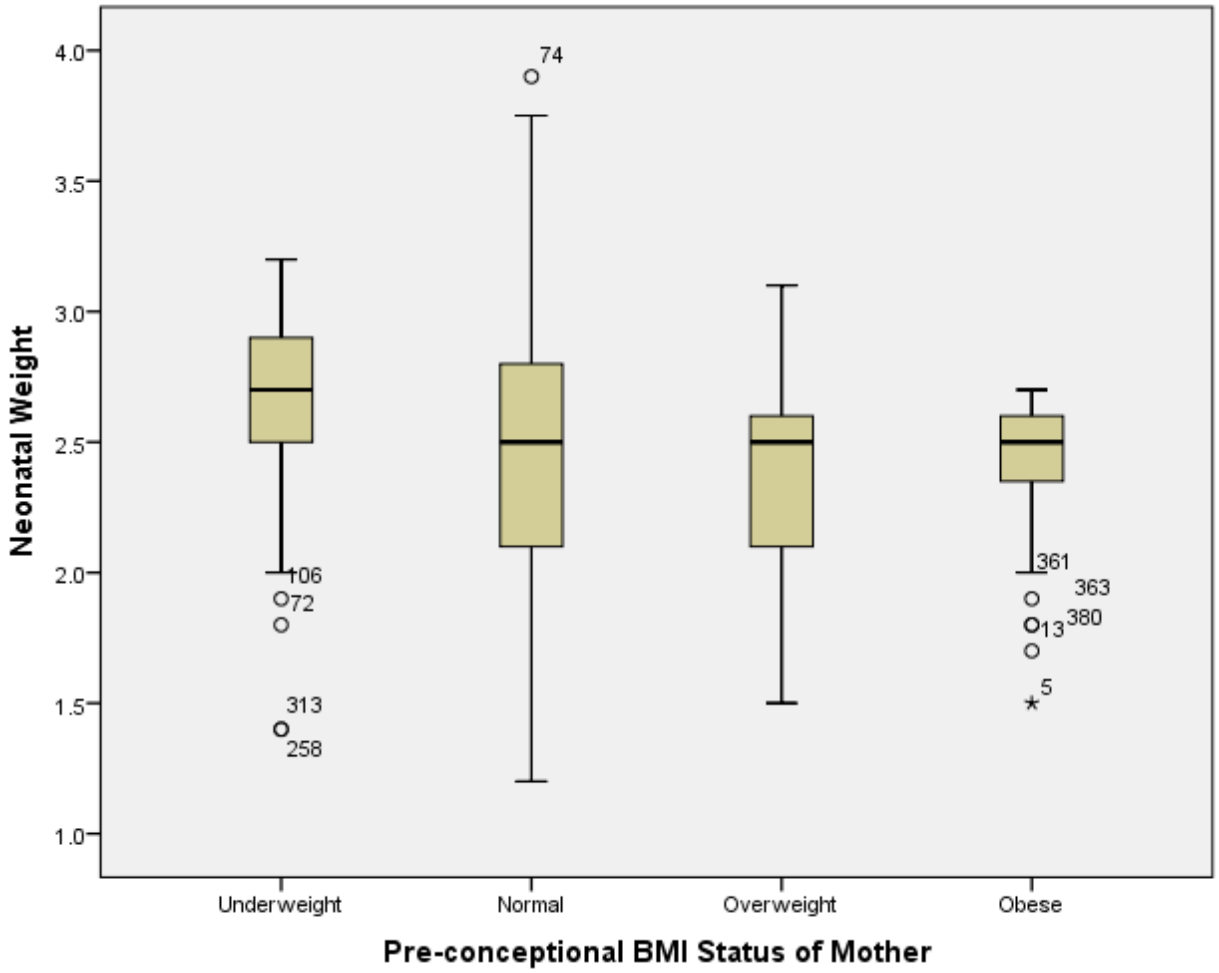

Figure 3 Box plot graph for the neonatal birthweight to the pre-conceptional BMI status of respective mothers.

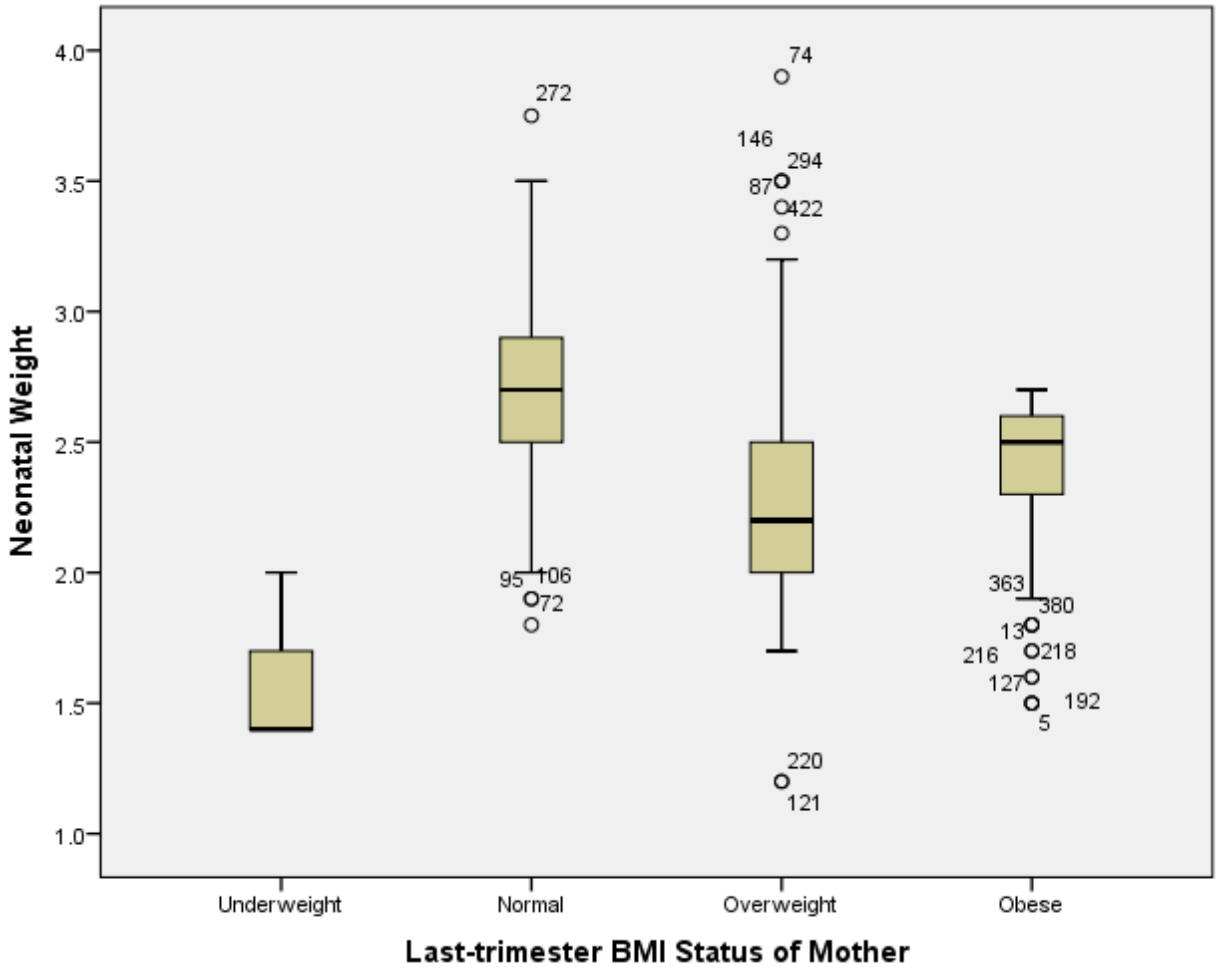

Figure 4 Box plot graph for the neonatal birthweight to the last trimester BMI status of respective mothers.