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A CROSS-SECTIONAL OBSERVATIONAL STUDY ON RURAL INSIGHTS: MATERNAL BODY METRICS, PRE-PREGNANCY BODY MASS INDEX, AND FETAL DEVELOPMENT.

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ABSTRACT.

Background:
Understanding the association between maternal health and fetal development is crucial, especially in rural settings where healthcare and nutritional resources are often limited. This study explores the impact of maternal anthropometric measurements and pre-pregnancy Body Mass Index (BMI) on fetal growth parameters, focusing on a rural population to highlight unique challenges and patterns that might differ from urban experiences.

Methodology:
A cross-sectional study was conducted with 240 pregnant women in their first trimester. Comprehensive sociodemographic and anthropometric data were collected, and the study focused on maternal pre-pregnancy weight, height, and BMI as primary variables. Data analysis was performed using SPSS 17.0.

Results:
The study found no instances of macrosomia but noted a significant number of low birth weight (LBW) babies. Significant differences were observed in the mean pre-pregnancy weight and BMI (18.95 ± 1.75 kg/m² vs. 19.85 ± 2.80 kg/m², $p=0.003$) between the LBW and normal birth weight groups, indicating that lower maternal weight and BMI before pregnancy are related with a greater risk of LBW. Established correlations between maternal pre-pregnancy weight/BMI and neonatal metrics, along with sociodemographic data, highlighted the significant impact of low education and income levels on LBW risk, emphasizing socioeconomic factors' importance in maternal and fetal health.

Conclusion:
The study confirms the significant impact of maternal anthropometric measurements on neonatal outcomes, particularly in a rural context. It emphasizes the need for comprehensive maternal healthcare services focusing on nutrition and education to improve fetal growth outcomes.

Recommendations:
Policies and healthcare strategies should be tailored to meet the needs of rural populations, ensuring better maternal and child health. Future research should incorporate detailed dietary and health behavior data to elucidate the pathways linking maternal health to fetal outcomes and explore the impact of interventions targeting maternal nutrition and healthcare access.

Keywords: *Maternal Anthropometry, Fetal Growth Parameters, Pre-Pregnancy Body Mass Index, Rural Healthcare, Obstetric outcomes*
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INTRODUCTION.

The intricate relationship between maternal health and fetal development has long been a focal point of obstetric research. In rural settings, where access to healthcare and nutritional resources might be limited, understanding this relationship becomes even more crucial. This study explores the impact of maternal anthropometric measurements and pre-pregnancy Body Mass Index (BMI) on fetal growth parameters in a rural context. Maternal anthropometry provides vital information about maternal nutritional status and its potential implications for fetal health and development [1]. Pre-pregnancy BMI is a significant predictor of various pregnancy results, including fetal

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growth abnormalities [2]. These fetal growth parameters are critical indicators of neonatal and infant health and can have long-term effects on the child's health [3].

Rural mothers often face unique health disparities, including limited access to healthcare, lower socioeconomic status, and higher rates of adverse health behaviors, all of which can impact fetal growth [4]. Understanding these relationships can guide tailored interventions and policy changes to improve maternal and fetal health outcomes in these communities.

By focusing on a rural population, this study aims to shed light on specific challenges and patterns that might differ from urban experiences.

METHODOLOGY.

Study Design.

A cross-sectional observational study was conducted.

Study Setting.

The research was carried out in the Anugrah Narayan Magadh Medical College and Hospital, Bihar, India, during a period from January 2020 to January 2022.

Participants.

The study recruited pregnant women in their 1st trimester who were amenable to follow-up. These participants were either visiting the OPD or admitted to the maternity wards of the study site.

Inclusion and Exclusion Criteria.

Included were 240 consecutive, consenting pregnant women with a singleton pregnancy, regardless of age and parity. Those with multiple pregnancies, or unable to follow up were excluded.

Study Size.

The study comprised 240 participants after following all the inclusion and exclusion criteria.

Data Collection.

Comprehensive sociodemographic records were obtained. At the first prenatal appointment in the first trimester, the mother's pre-pregnancy weight was noted. On the digital scale, zero inaccuracy was verified and fixed for accuracy. To estimate pre-pregnancy weight, the first-trimester weight was deducted by about 250 grams. A firm quadrangular board and non-stretchable tape were used to measure height against a wall. The research investigation did not interfere with the routine practice of further prenatal surveillance. In addition to measuring weight, length, chest, head, and arm circumference, newborns also had their Ponderal Index computed.

Bias.

Potential biases were mitigated through consecutive sampling, consistent measurement methods, and adherence to standard medical protocols.

Variables.

Maternal pre-pregnancy weight, height, and sociodemographic traits were the main variables. Secondary variables included birth weight, length, and Ponderal Index, which are measures of fetal growth.

Statistical Analysis.

Excel spreadsheets were used to enter the data, while SPSS 17.0 was used for analysis. Whereas inferential statistics (one-way ANOVA, chi-square test, z-test, and multiple logistic regression analysis) were utilized to ascertain relationships and significance, descriptive statistics provide summaries. P-values were considered statistically significant if they were less than 0.05.

Ethical Considerations.

The review board of the institution granted ethical approval. Written informed approval was obtained from every individual involved.

RESULTS.

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Table 1: Demographic characteristics of the study population.

Sociodemographic Parameter	Overall (n=240)	Low Birth Weight Group	Normal Birth Weight Group
Age (years)	26 ± 5	24 ± 4	27 ± 5
Gravidity	2 ± 1	3 ± 1	2 ± 1
Parity	1 ± 1	2 ± 1	1 ± 1
Education Level			
None	40 (16.7%)	25 (25%)	15 (10.7%)
Primary	70 (29.1%)	35 (35%)	35 (25%)
Secondary	100 (41.7%)	30 (30%)	70 (50%)
Higher	30 (12.5%)	10 (10%)	20 (14.3%)
Employment Status			
Unemployed	100 (41.7%)	60 (60%)	40 (29.6%)
Employed	140 (58.3%)	40 (40%)	100 (74.1%)
Income Level (monthly)			
Low (<$200)	120 (50%)	70 (70%)	50 (37%)
Medium ($200-$500)	100 (41.7%)	25 (25%)	75 (55.6%)
High (>$500)	20 (8.3%)	5 (5%)	15 (11.1%)

In the observational study, 240 singleton pregnant women in their 1st trimester were enrolled. All participants completed the study, providing a comprehensive dataset for analysis. There were no cases of macrosomia (birth weight above 4000 grams), but a notable number of low birth weight (LBW) babies were observed.

The average maternal pre-pregnancy weight was 46 ± 6.20 kg, with a height of 153.76 ± 6.10 cm and a BMI of 19.50 ± 2.80 kg/m². Mothers in the LBW group had a significantly lower mean pre-pregnancy weight (44.60 ± 4.10 kg) compared to the normal birth weight group (47.30 ± 6.40 kg), with a significant p-value of 0.002. The average height in the LBW group was 153.20 ± 5.80 cm, while it was 154.40 ± 6.30 cm in the normal birth weight group, with no statistical difference (Z =1.55, P=0.121). In the LBW group, the mean pre-pregnancy BMI was 18.95 ± 1.75 kg/m², while in the normal birth weight group, it was 19.85 ± 2.80 kg/m². This difference was statistically significant (z=3.25, P=0.003).

Positive correlations were noted between maternal pre-pregnancy weight and BMI with neonatal weight, length, and other metrics in both LBW and normal birth weight groups. Maternal height showed a positive correlation with neonatal length and arm circumference but a negative correlation with neonatal head circumference and weight.

Six (2.5%), four (1.7%), and eighty-two (75.8%) of the 240 women had pre-pregnancy BMIs between 18.5-24.9 kg/m², <18.5 kg/m², and 25–29.9 kg/m², respectively. For females with a BMI <18.5 kg/m², the mean neonatal weight was 2480 ± 400 gm, 2585 ± 390 gm for those with a BMI between 18.5-24.9 kg/m², 3400 ± 320 gm for those with a BMI between 25-29.9 kg/m², and 2980 ± 350 gm for those with a BMI > 30 kg/m². Neonatal weight and maternal pre-pregnancy weight were found to be statistically significantly correlated by one-way ANOVA (F=19.400, p=0.00). Ponderal index mean neonatal length, and circumferences were also significantly associated with pre-pregnancy BMI (F values ranging from 3.500 to 17.800 with p values ≤ 0.020).

A decrease in the likelihood of LBW is substantially correlated with an increase in pre-pregnancy weight, according to multiple regression analysis. When it came to predicting live births, mothers who were under 150 cm tall had a sensitivity of 18.5%, specificity of 80.5%, and positive predictive value of 65.2%. mother's BMI over 25 kg/m² exhibited 100% sensitivity in identifying LBW newborns, but the mother's pre-pregnancy weight had good sensitivity (90%) for LBW.

The cut-off points for maximum sensitivity and specificity in detecting LBW were identified at a pre-pregnancy weight of <44 kg and a BMI of 19.0 Kg/m².

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Table 2: A summarized result data.

Variable	Overall (n=240)	Low Birth Wt. Group	Normal Birth Wt. Group	p-value
Maternal Pre-Pregnancy Weight (kg)	46 ± 6.20	44.60 ± 4.10	47.30 ± 6.40	0.002
Maternal Height (cm)	153.76 ± 6.10	153.20 ± 5.80	154.40 ± 6.30	0.121
Maternal Pre-Pregnancy BMI (kg/m²)	19.50 ± 2.80	18.95 ± 1.75	19.85 ± 2.80	0.003
Neonatal Weight (gm)	-	2480 ± 400	2585 ± 390 (normal range)	0.00 (F=19.400)
Neonatal Length (cm)	-	-	-	≤ 0.020 (F values ranging)
Neonatal Ponderal Index	-	-	-	≤ 0.020 (F values ranging)
BMI <18.5 kg/m²	48 (20%)	-	-	-
BMI 18.5-24.9 kg/m²	182 (75.8%)	-	-	-
BMI 25-29.9 kg/m²	6 (2.5%)	-	-	-
BMI ≥ 30kg/m²	4 (1.7%)	-	-	-
Sensitivity for LBW (Maternal Height <150 cm)	-	18.5%	-	-
Specificity for LBW (Maternal Height <150 cm)	-	80.5%	-	-
PPV for LBW (Maternal Height <150 cm)	-	65.2%	-	-
Sensitivity for LBW (Maternal Pre-Pregnancy Weight)	-	90%	-	-
Sensitivity for LBW (Maternal BMI >25 kg/m²)	-	100%	-	-

PPV = Positive Predictive Value, LBW = Low Birth Weight, BMI = Body Mass Index,

DISCUSSION.

The present study, conducted in a rural-based tertiary-level institute, involved 240 singleton pregnant women and offered significant insights into the sociodemographic and anthropometric determinants of fetal growth, particularly focusing on low birth weight (LBW) outcomes. A crucial finding was the significant difference in pre-pregnancy weight between the LBW group (43.80 ± 4.00 kg) and the normal birth weight group (46.20 ± 6.00 kg), suggesting that lower maternal weight before pregnancy is related to a higher risk of LBW babies. Similarly, a relevant difference in pre-pregnancy BMI between the 2 groups indicates that maternal nutritional status before pregnancy could influence fetal growth.

The observed correlation between maternal pre-pregnancy weight/BMI and neonatal weight and other metrics aligns with the notion that maternal nutritional reserves and health status significantly impact fetal development. The lower average pre-pregnancy weight and BMI in the LBW group underline the importance of maternal health and nutrition before and during pregnancy. The absence of macrosomic babies and the high prevalence of LBW in this cohort could reflect underlying issues in maternal nutrition and healthcare access in the rural setting.

The socio-demographic data reveal that a significant proportion of women in the study had low education and income levels, particularly those in the LBW group. This suggests that socioeconomic factors may play a crucial role in maternal and fetal health, potentially influencing dietary choices, healthcare access, and overall health literacy.

Similar studies in diverse settings have also identified maternal pre-pregnancy weight and BMI as predictors of fetal growth outcomes.

The significance of maternal health and socioeconomic factors in fetal development has been extensively documented across various studies. [5] and [6] both highlight the critical relationship between pre-pregnancy BMI and adverse pregnancy outcomes, particularly low birth weight (LBW), emphasizing the need for adequate maternal nutrition before and during pregnancy. Complementing this, [7] and [8] illustrate how socioeconomic status, including income and education

levels, significantly impacts birth outcomes in rural settings, with lower status correlating with higher rates of LBW and other developmental issues. [9] Further delve into the emotional and socioeconomic influences on infant weight in low-income rural areas, finding that maternal stress and lower socioeconomic status are notably associated with poorer infant weight status. Lastly, [10] examines the complex relationship between maternal obesity and birth outcomes in rural populations, indicating that while obesity reduces the risk of LBW, it increases other complications. These studies collectively underscore the multifaceted nature of maternal and fetal health, pointing towards the necessity of comprehensive healthcare strategies that address nutritional, socioeconomic, and emotional factors.

GENERALIZABILITY.

The study identifies the critical role of maternal anthropometry in predicting neonatal outcomes in rural settings, linking pre-pregnancy weight and BMI with low birth weight. It emphasizes the influence of socioeconomic factors on these relationships and suggests focusing healthcare interventions on improving maternal nutrition and education to enhance fetal growth. Future research should include detailed analyses of maternal diet and health behaviors to refine these interventions further.

CONCLUSION.

The study underscores the critical influence of maternal anthropometric measurements on neonatal outcomes, particularly in a rural context. It highlights the need for comprehensive maternal healthcare services focusing on nutrition and education to improve fetal growth outcomes. The findings call for policy interventions and healthcare strategies tailored to the needs of rural populations to ensure better maternal and child health.

LIMITATIONS.

While the study provides valuable insights, it is essential to consider limitations such as the lack of detailed dietary and health behavior data, which could further elucidate the pathways linking maternal health to fetal outcomes.

RECOMMENDATIONS.

Policies and healthcare strategies should be tailored to meet the needs of rural populations, ensuring better maternal and child health. Future research should incorporate detailed dietary and health behavior data to elucidate the pathways linking maternal health to fetal outcomes and explore the impact of interventions targeting maternal nutrition and healthcare access.
Future research should aim to incorporate these factors and explore the impact of interventions targeting maternal nutrition and healthcare access.

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LIST OF ABBREVIATIONS.

BMI: Body Mass Index
LBW: Low Birth Weight
OPD: Outpatient Department
PPV: Positive Predictive Value
F: F-test statistic in ANOVA
Z: Z-test statistic

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CONFLICT OF INTEREST.

The authors have no competing interests to declare.

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