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MATERNAL DIETARY PATTERN AND ITS ASSOCIATION WITH BIRTHWEIGHT IN TERTIARY CARE CENTER IN SOUTH INDIA: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: Nutritional deficits and the lack of sufficient food consumption among pregnant women not only adversely affect the mother's health but also impact the development and even the birth weight of the foetus. **Aim:** This study examined the connections between a mother's dietary variety score and her eating patterns during pregnancy, as well as the likelihood of having a low birth weight baby at the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu. **Methods:** Mothers who will be present at the postnatal clinic at the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu, from January 2023 to August 2023. Anthropometric parameters including pre-pregnancy weight, height, BMI, total weight gain, and birth weight of the babies during pregnancy was taken and added along with mothers' interview to measure the bio-social variables of the mothers. The main measure of interest was low birth weight, which was defined as a weight of less than 2500 g at the time of birth. SPSS was used to conduct a statistical analysis the frequency or occurrence rate. **Results:** The incidence of neonates with low birth weight was 63.33%. Those born earlier (68%) were predominantly preterm borns while those born late were due to intrauterine growth restriction (IUGR) (32%). What is more, approximately 45% of mothers who gave birth to babies with lower birth weights had a low BMI during the whole pregnancy and before it started. The data indicated that the mean weight at birth was about 2.463 grams. **Conclusion:** Mother's health is crucial for baby birth weight, and nutrition programs should focus on screening and treating at-risk women, reducing low-birth-weight infant burden, and promoting better maternal protein.

Keywords: Maternal Nutrition, Birth Weight, Maternal Health, Pregnancy, BMI, Gestational Weight Gain.

INTRODUCTION

Low birth weight (LBW) is defined by the World Health Organization (WHO) as a birth weight that is less than 2500 g (5.5 pounds) [1]. Research grounded in the theory of Developmental Origins of Health and Diseases (DOHaD) indicates that infants with low birth weight (LBW) are more likely to develop hypertension, obesity, diabetes, and experience higher mortality rates in adulthood compared to infants with a normal birth weight[2]. Studies have identified socio-economic variables, maternal nutritional condition before and throughout pregnancy, and maternal anthropometric parameters as risk factors for low birth weight[3]. The relationship between the socio-economic features of mothers and their nutritional state during pregnancy is known to have an impact on low birth weight[4]. The World Health Organization (WHO) states that inadequate maternal nutrition during pregnancy increases the likelihood of low birth weight (LBW) in underdeveloped nations, such as Ghana[5].

Consuming sufficient food or nutrients during pregnancy allows for the accumulation of maternal nutrient reserves, which can be utilized as nutritional stocks throughout pregnancy[6]. While it can be beneficial to examine the effects of individual nutrients or foods, the findings may not fully capture the intricate dynamics of food intake and nutrient combinations throughout pregnancy. Hence, it is more beneficial to examine dietary diversity and patterns, rather than focusing on individual nutrients or food groups, in order to comprehend the connection between overall maternal nutrition sufficiency during pregnancy and birth outcomes. This is particularly relevant in regions where evaluating diets is intricate and frequently challenging[7].

The Dietary Diversity Score (DDS) is a valuable measure that indicates the sufficiency of nutrients or the overall quality of a diet[8]. Consuming a varied diet from various food groups and sources during pregnancy is a crucial strategy to enhance the quality of one's diet and the levels of essential nutrients throughout pregnancy [9]. A recent prospective cohort study conducted in Ethiopia found that achieving a dietary diversity score (DDS) of four (4) during pregnancy was linked to a lower risk of maternal anemia, low birth weight (LBW), and pre-term birth. Conversely, women who had lower dietary diversity scores (DDS) during pregnancy had a greater likelihood of giving birth to a higher proportion of infants with low birth weight (LBW) compared to those who had medium and higher DDS[10].

Low birth weight is a significant public health issue globally, defined by the World Health Organization as infants weighing less than 2500 grams at birth 1. In India, approximately 7-8% of births are low birth weight cases, contributing to 5-10% of all neonatal deaths worldwide [11]. Factors associated with low birth weight in India include maternal tobacco use[12], maternal depression[13], maternal age, height, weight gain during pregnancy, and anemia[14]. Placental factors also play a role in a considerable proportion of low birth weight cases[15]. Low birth weight infants are at a higher risk of being stunted, wasted, and underweight during childhood[16].

Birth weight is a crucial indicator of fetal growth and development, reflecting both maternal health and the intrauterine environment. Low birth weight, defined as less than 2500 grams at birth, is a significant global public health concern due to its association with adverse health outcomes in infancy and later life. Infants born with low birth weight are more vulnerable to infections, developmental delays, and chronic health conditions such as diabetes and cardiovascular diseases in adulthood. The impact extends beyond infancy, affecting long-term health outcomes like metabolic disorders, obesity, hypertension, and cardiovascular diseases in adulthood [17-19].

Maternal health and nutrition before and during pregnancy play a crucial role in pregnancy outcomes. Insufficient diet or low nutritional status during pregnancy can adversely affect maternal and child health, leading to lower birth weight and compromised fetal development. In many developing countries, most cases of low birth weight are attributed to intrauterine growth restriction (IUGR), which can result from factors such as lack of nutrition, maternal infection, and increased nutritional requirements[20-22].

Maternal anthropometry, including pre-pregnancy weight, BMI, and total weight gain during pregnancy, significantly influence fetal growth and birth weight. Low BMI and inadequate weight gain during pregnancy can serve as biomarkers for IUGR. Improving maternal nutrition, enhancing access to healthcare, and addressing social

determinants of health are essential steps in reducing the burden of low birth weight and promoting optimal infant health and development [23-26].

Furthermore, adequate gestational weight gain is crucial for healthy fetal growth, emphasizing the importance of maternal nutrition and weight management during pregnancy. Maternal weight changes from the first to the second trimester are strongly associated with fetal growth, highlighting the need for continuous monitoring and support for pregnant women [23,26].

Efforts to address low birth weight in India include interventions like Kangaroo Mother Care (KMC), which have shown promise in improving the growth and morbidity patterns of low birth weight infants [27]. However, further research is needed to fully understand and address the complexities surrounding low birth weight in the country[27]. In low birth weight remains a significant public health challenge in India, impacting neonatal mortality and long-term health outcomes. Targeted interventions and research are crucial in reducing the prevalence of low birth weight and improving outcomes for infants in the country.

METHODOLOGY

Study setting: The study was done in the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu. The study design and selection of participants: This study was conducted in a hospital setting and followed a cross-sectional design. The study population consisted of moms who visited the postnatal clinic at the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu metropolitan hospital between January 2023 and August 2023. We recruited moms who were 17 years old and had attended both the Antenatal clinic (ANC) and delivered at the same facility, and were currently attending the postnatal clinic

We employed a systematic sampling method to choose eligible individuals from the midwife's appointment register on postnatal clinic days. Among the entire population of women who received antenatal care (ANC) and gave birth at the institution, a total of 483 moms consented to take part in the study. We excluded moms who experienced stillbirths, gave birth to newborns with severe congenital abnormalities, and those who delivered infants with above-average birth weight. In total, 322 moms were included in the final analysis.

The study aimed to investigate the weight of newborn infants and their development from conception to birth. Data was collected from mothers' birth records and anthropometric measurements, including weight, height, and BMI. The study also assessed the mother's weight and overall health during pregnancy. The weight increase during pregnancy was calculated by subtracting the weight measured at the first antenatal care visit from the last. The pre-pregnancy BMI was classified as underweight, normal, overweight, or obese. Demographic features such as education level, income, and marital status were collected through a questionnaire. Dietary data was evaluated using a food frequency questionnaire (FFQ), which included 52 food items modified to cater to the most prevalent dietary preferences of metropolis residents.

Every expectant mother gave their consent in writing after being fully informed. Approval was received from the institutional Ethical Committee of the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu. The data obtained from the medical records were treated with utmost confidentiality. Neither the case records nor the

extracted data were utilized for any additional purposes, and all information gathered from expectant moms was preserved in an anonymous manner.

RESULTS

Table 1: The Sociodemographic Characteristics of Pregnant Women Receiving Antenatal Care Services at the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu

Maternal profile Categories	Frequency (%)
Age group (in years)	
≤24	34.37
25–29	31.53
30–34	18.1
35–39	14.12
≥ 40	1.2
Residence	
Urban	81.7
Rural	18.3
Religion	
Hindu	83.77%
Christian	9.74%
Muslim	5.19%
Others	1.30%
Type of family	
Nuclear	83.12%
Joint	16.88%
Maternal educational status	
Unable to read and write	2.65
Primary school completed	39.98
Secondary school completed	24.67
Diploma and above	33.71
Maternal occupational status	
Housewife	43.11
Farmer	4.24
Merchant	26.38
Government employees	10.9
Non-governmental employees	12.26
Others	3.11
Monthly family income Rs:	
Less than 10,000	9.09%
11,000-20,000	11.04%
21,000-40,000	24.03%
41,000-60,000	25.97%
61,000-75,000	9.09%
76,000-90,000	7.14%
More than 90,000	13.64%

The sociodemographic characteristics of pregnant women receiving antenatal care at Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu, reveal a diverse yet predominantly young and urban population. The majority of these women are aged 24 or younger (34.37%) or between 25 to 29 years (31.53%), with fewer women in the older age brackets. Most of the women reside in urban areas (81.7%) and belong to Hindu families (83.77%), with a significant number living in nuclear family setups (83.12%).

Educationally, a substantial portion has completed primary school (39.98%) or holds a diploma or higher qualification (33.71%). Occupationally, many are housewives (43.11%), but others are engaged in merchant activities (26.38%), government employment (10.9%), or non-governmental employment (12.26%). Family income levels vary, with a notable proportion earning between Rs. 21,000 to Rs. 60,000 per month.

This data highlights the economic and educational diversity among the pregnant women attending this medical center.

Table 2: Reproductive Health Characteristics, Medical, and Risky Behavioral Factors of Pregnant Women Receiving Routine Antenatal Care Service in the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu

Maternal Profile Categories	Frequency (%)
Birthweight of the newborn (mean ± SD)	2325 (±360) g
Age at first pregnancy (median, IQR)	21 (19–23) years
Gestational age at delivery (median, IQR)	38.1 (36.8–39.1) weeks
Birth interval (median, IQR)	23 (19.5–34) months
Age at First Pregnancy (in years)	
18–28 years	90.10%
29–39 years	9.90%
Gravidity	
Primigravida	0.28%
Multigravida	88.42%
Grand-multigravida	11.30%
Newborn Birthweight Categories	
Low birthweight	63.30%
Normal birthweight	31.72%
Macrosomia	5.02%
Gender of the Newborn	
Male	48.56%
Female	51.44%
Mode of Delivery of the Newborn	
Vaginal delivery	44.75%
Cesarean delivery	55.25%

The maternal profile data shows that the mean birthweight of newborns is 2325 grams with a standard deviation of ±360 grams. The median age at first pregnancy is 21 years, with an interquartile range (IQR) of 19–23 years.

The median gestational age at delivery is 38.1 weeks (IQR: 36.8–39.1 weeks), and the median birth interval is 23 months (IQR: 19.5–34 months). Most mothers had their first pregnancy between 18–28 years (90.10%), while 9.90% were between 29–39 years. In terms of gravidity, 0.28% were primigravida, 88.42% were multigravida, and 11.30% were grand-multigravida.

For newborn birthweight categories, 63.30% had low birthweight, 31.72% had normal birthweight, and 5.02% had macrosomia. The gender distribution of newborns was fairly even, with 48.56% male and 51.44% female. Regarding the mode of delivery, 44.75% were vaginal deliveries, and 55.25% were cesarean deliveries.

Table: 3 Nutritional Status of Pregnant Women Receiving routine Antenatal Care Service in the Ganga Medical Centre and Hospitals in Coimbatore, Tamilnadu

Nutritional Characteristics	Categories	Frequency (%)
Maternal hemoglobin level (median, IQR), g/dL		11.03 (10.3–13.1)
Gestational weight gain (GWG) (median, IQR), kg		9.5 (8–12)
Women's dietary diversity scores (WDDs) (median, IQR)		4 (3–5)
Ever heard about nutrition during pregnancy	Yes	90.05%
	No	9.95%
Sources of information for nutritional counseling	Television	22.45%
	Radio	3.26%
	Newsletters	3.83%
	Health workers	68.46%
Feeding frequency during pregnancy	≤3 times/day	29.50%
	>3 times/day	70.50%
Pregnant mothers who omitted food items during pregnancy	Yes	37.51
	No	62.49%
Food taboo in the community for pregnant women	Yes	52.54%
	No	47.46%
Fasting during pregnancy	Yes	12.36%
	No	87.64%
Maternal nutritional supplementation during pregnancy	Supplemented	84.29%
	Not supplemented	15.71%
Nutritional supplementation type	Iron–folic acid	89.60%
	Multivitamin	10.36%
Maternal anemia status based on hemoglobin level	Anemic	43.67%
	Non-anemic	56.33%
Gestational weight gain (GWG)	Low	60.58%
	Normal	36.31%
	High	3.11%
Women's dietary diversity scores (WDDs)	Low diet diversity score	86.14%
	High diet diversity score	13.86%

The nutritional status of pregnant women receiving routine antenatal care at the Ganga Medical Centre and Hospitals in Coimbatore, Tamil Nadu, shows several key findings. The median maternal hemoglobin level is 11.03 g/dL, with an interquartile range (IQR) of 10.3–13.1 g/dL. The median gestational weight gain (GWG) is 9.5 kg (IQR: 8–12 kg), and the median women's dietary diversity score (WDDs) is 4 (IQR: 3–5). A high percentage (90.05%) of women have heard about nutrition during pregnancy, with health workers being the primary source of information (68.46%).

Feeding frequency data indicate that 70.50% of women eat more than three times a day, while 29.50% eat three times or less. About 37.51% of pregnant mothers omitted food items during pregnancy, and 52.54% reported food taboos in their community. Fasting during pregnancy was noted in 12.36% of the women. Regarding supplementation, 84.29% received nutritional supplements, primarily iron–folic acid (89.60%), with a smaller percentage taking multivitamins (10.36%). Maternal anemia is present in 43.67% of the women based on hemoglobin levels. GWG classification shows that 60.58% have low weight gain, 36.31% have normal weight gain, and 3.11% have high weight gain. Lastly, the WDDs reveal that 86.14% of the women have a low diet diversity score, while 13.86% have a high diet diversity score.

DISCUSSION

The present study found that The data from Ganga Medical Centre and Hospitals in Coimbatore provides insights into the nutritional status of pregnant women receiving antenatal care. A significant 90.05% of women demonstrate a high level of awareness regarding pregnancy nutrition, with health workers being the primary source of information for 68.46% of these women. This reliance on health workers is crucial for disseminating accurate knowledge. Approximately 70.5% of women follow a healthy eating pattern by consuming meals more than three times a day, indicating a fundamental level of nutritional intake 1. Moreover, a large percentage (84.29%) of these women receive nutritional supplementation, mainly in the form of iron-folic acid (89.60%), which is essential for addressing potential deficiencies during pregnancy which is corelating with previous study by Olander et.al 2011[28].

King J et all 2016 studied The prevalence of low birth weight among newborns is a significant concern, with a substantial proportion of cases attributed to preterm birth. This highlights the critical role of gestational age in determining birth weight outcomes [29]. Roland (2014) found Maternal factors, such as low maternal BMI and inadequate gestational weight gain, have been identified as significant risk factors for delivering low birth weight infants[30]. Hambidge et al studies proven that Addressing preterm birth and optimizing maternal nutrition and health during pregnancy are crucial in shaping fetal growth and development[31].

However, the data also highlights concerning aspects that require attention and intervention. A notably high prevalence of anemia, affecting 43.67% of the women, emphasizes the need to address iron and folic acid absorption issues or implement additional interventions to combat this health concern. Furthermore, a substantial 86.14% of the women exhibit low dietary diversity scores, suggesting a lack of variety in their food choices, which could lead to nutritional deficiencies. The data also indicates that a significant proportion of women (29.50%) skip meals, indicating potential gaps in their nutritional intake. Additionally, prevalent food taboos (52.54%) and instances of fasting during pregnancy (12.36%) further complicate the nutritional status of these women. Moreover, a concerning 60.58% of the women experience low gestational weight gain, which can have adverse implications for both maternal and fetal health[28].

Research indicates that maternal nutrition during pregnancy plays a pivotal role in modulating fetal growth through factors like insulin-like growth factors and placental nutrient sensing[32-33]. Additionally, Zhang 2019 proven that maternal dietary protein and amino acids significantly impact offspring development[34]. Proper maternal nutrition before and during pregnancy is highlighted as a modifiable factor to improve fetal growth outcomes [35].

To address these challenges and enhance the nutritional status of pregnant women receiving antenatal care at Ganga Medical Centre and Hospitals, a comprehensive approach is essential. Targeted interventions are needed to address the high prevalence of anemia by improving iron and folic acid absorption or introducing alternative strategies . Dietary counseling is crucial to tackle the low dietary diversity scores observed among the women, emphasizing the importance of incorporating a wide range of nutritious foods into their diets. Addressing prevalent food taboos and misconceptions through educational initiatives can promote a balanced diet during pregnancy, encouraging better nutritional practices. Monitoring and providing

guidance on adequate nutrient intake to optimize gestational weight gain is vital for the well-being of both mothers and babies.

Enhancing antenatal education by involving dieticians or nutritionists to provide group or individual counseling on healthy eating habits during pregnancy could be beneficial in improving the nutritional status of pregnant women . Providing culturally sensitive guidance that addresses food taboos and integrates traditional foods into balanced meal plans can enhance adherence to healthier dietary practices . Engaging with local communities to raise awareness about the importance of good nutrition during pregnancy is another effective strategy to empower pregnant women to make informed dietary choices and enhance pregnancy outcomes for both mothers and babies. By implementing these holistic approaches, Ganga Medical Centre and Hospitals can play a crucial role in promoting optimal nutrition among pregnant women and fostering positive health outcomes during pregnancy.

Furthermore, Jansson(2013) studies shows altered maternal nutrition and metabolic factors can disturb critical periods of fetal development, leading to increased susceptibility to diseases in childhood and adulthood [36]. Maternal weight gain throughout pregnancy is strongly associated with fetal growth, emphasizing the importance of monitoring maternal weight to optimize birth weight outcomes [37]. Placental weight is also an independent determinant of fetal growth and birth weight, further emphasizing the complex interplay between maternal health and birth weight outcomes [31].

The findings underscore the importance of targeted interventions aimed at improving maternal nutrition, optimizing gestational weight gain, and addressing preterm birth to promote optimal birth weight outcomes and enhance infant health. By understanding the intricate relationship between maternal factors and birth weight outcomes, interventions can be tailored to ensure healthier outcomes for both mothers and newborns.

CONCLUSION

The study highlights the importance of maternal nutrition in fetal growth and birth weight outcomes, with maternal undernutrition being a significant determinant of low birth weight. Interventions to promote healthy lifestyles during pregnancy, raise awareness, and implement evidence-based interventions are crucial for improving birth weight and infant health.

Limitations:

As this was a single center study with a comparatively short sample size, results of this study cannot be generalized. Generalization requires the support of results from similar large studies

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Conflicts of Interest: There are no conflicts of interest**.**

Ethical Statement:

Institutional ethical committee accepted this study. The study was approved by the institutional human ethics committee, Ganga institute of health sciences, Coimbatore, Tamilnadu. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

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Authors' Contributions:

Rajani Merlin Sam - conceptualization, data curation, investigation, methodology, project administration, visualization, writing—original draft, writing—review and editing; ***Dr.R.Naganandini*** -conceptualization, methodology, writing—review and editing, supervision; ***Dr.Esther John***- Analysed and interpreted the data, writing—original draft, methodology. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work. All authors have read and agreed to the published version of the manuscript**.**

Data Availability:

All datasets generated or analyzed during this study are included in the manuscript.

Informed Consent:

Written informed consent was obtained from the participants before enrolling in the study

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Use of Artificial Intelligence

The author has taken the assistance of Grammarly and Google Gemini for better readability and language improvement, but have rechecked the contents for their authenticity and take the full responsibility.

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