ASSOCIATION OF MATERNAL BOOKING VISIT BMI AND WEIGHT GAIN DURING PREGNANCY WITH BIRTH WEIGHT OF THE BABY AND EARLY NEONATAL OUTCOMES: FINDINGS FROM TEACHING HOSPITAL ANURADHAPURA

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ABSTRACT

Introduction

Maternal weight gain during pregnancy is considered as a key determinant in early neonatal outcomes. The association between maternal booking visit body mass index (BMI), weight gain during pregnancy, and the resulting birth weight of infants and early neonatal outcomes were assessed in this study.

Method

An observational cross-sectional study was conducted with postnatal mothers in postnatal wards of Teaching Hospital Anuradhapura, Sri Lanka.

Results

Among 440 participants, 73.4% were unemployed and 93% were Sinhalese. The mean age was 28.45 years, with 72% having fewer than three pregnancies and in 80% parity was <3. At booking visits the prevalence of normal BMI was 52%. Mean birth weight was 2.98 kg, with intrauterine growth restriction present in 1.6%. PBU care was given for 4.1%. Only the parity of mothers had significant association for having PBU care (P=0.031). Maternal weight gain was significantly associated with age ($P < 0.001$), occupation ($P = 0.004$), gravidity (0.012), parity (0.006), children count (0.018) and diet history (P=0.039). A significant association was determined between maternal weight gain and past medical history, anemia, diet history, booking visit BMI, and birth weight ($P < 0.05$).

Conclusion

A significant association was not found between maternal weight gain during pregnancy and birth weight of the baby which warrants further studies. Maternal weight gain during pregnancy is determined by various factors. It is recommended that targeted interventions for pregnant women be implemented by healthcare providers to promote healthy weight gain and optimize neonatal outcomes.

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CHAPTER 01: INTRODUCTION

Weight gain during pregnancy is an area of controversy despite numerous studies which have been conducted. In 1990, the Institute of Medicine (IOM) released guidelines for weight gain during pregnancy, according to the pre-pregnancy BMI (Body Mass Index) of women (1). The pre-pregnancy BMI and gestational weight gain (GWG) have increased among all population groups worldwide in recent past with prevalence of high rates of women who are overweight and obese, that are at an increased risk for poor maternal as well as child health outcomes (2). In the current context with the worldwide epidemic of obesity, gaining an optimal healthy weight through pregnancy is of importance for the immediate and long-term health of the mothers other than the birth weight of the infant.

The new IOM guidelines vary from the previously issued 1990 guidelines in two ways given that they are built on the BMI category cutoff points according to World Health Organization (WHO) and the fact that the new guidelines include a comparatively narrow range of weight gain recommended for obese women (2). It is proposed that the clinicians should consider other medical evidence and changeable factors that could be contributing to excessive or insufficient gain in case that a woman's GWG is not within the recommended limits. Also, it is recommended that information on the nature of excessive gestational weight gain and consistency of the fetal growth should be properly assessed before advising a woman that she should modify her pattern of gestational weight gain (2).

The IOM guidelines are recommended for use among American women and might be appropriate to be applied on women in developed countries. Yet, they are not recommended to be used in other regions of the world with shorter or thinner women than the women in the United States or where the obstetric services are inadequate (2). Nevertheless, the current weight gain chart used in the Sri Lankan system is based on the new IOM guidelines and there is overemphasis on the gestational weight gain according to it. It is important to provide women with individualized dietary and exercise advice and where appropriate might require referral to a dietitian as well as other appropriately qualified individuals. Furthermore, the committee to Re-examine IOM Pregnancy Weight Guidelines states that these services may need to be continued into the postpartum period to give women the maximum guidance in order to come back to their pre pregnancy weight within the first year postpartum and to increase the possibility of returning to a normal BMI in preparation for their next conception.

Observational studies have demonstrated that it is more likely to have good birth outcomes when women conceive at a normal BMI and gain weight within the suggested limits than those who gain outside these suggested ranges (2). One study including 104 pregnant women concluded that maternal weight gain in the second and third trimesters showed statistically significant association with birth weight of the baby and adequate total maternal weight gain based on IOM recommendation results in a better outcome. Particularly in the second and third trimesters to neonatal birth weight outcomes. In this cohort of 104 pregnant women, total maternal weight gain ranged from 5 kg to 20 kg over the course of pregnancy, with peak gains occurring in the second and third trimesters. The authors found a statistically significant correlation between maternal weight gain and baby birth weight **(**$p = 0.03$, 95 % CI**),** indicating that as maternal gestational weight increased, infant birth weight tended to be higher**,** although the correlation was reported as weak**.** Babies classified as having normal birth weights (2,500–4,000 g; SD ±399.86) were more common among women with higher gestational weight gains. These findings suggest that adequate weight gain according to IOM recommendations is associated with improved birth weight outcomes, and that insufficient weight gain may be a risk factor for lower birth weights, even though the strength of the association was modest (3). A large study conducted including 513,501 women revealed that maternal weight gain during pregnancy increases birth weight independent of genetic factors (4). Banda et al. (2023) quantified the determinants of birthweight in a rural Sri Lankan setting, revealing several statistically significant contributors to neonatal weight at birth. Among 497 mother-infant pairs with complete data, the mean birthweight was 2,912 g (SD 456.6 g), and 14.6 % of infants were low birthweight (<2,500 g) (95 % CI 11.7–17.9 %) while 9.3 % weighed ≥3,500 g (95 % CI 7.0–12.1 %) at delivery. In hierarchical regression analysis, preterm birth was the strongest predictor, accounting for 6.9 % of the unique variance in birthweight ($p < 0.001$), followed by maternal early pregnancy BMI, which explained 3.9 % of variance ($p < 0.001$); specifically, a 1 SD increase in maternal BMI (≈4.8 kg/m^2) was associated with a 0.21 SD increase in birthweight (~119 g). Psychosocial wellbeing during mid-pregnancy also contributed significantly though to a lesser extent (1.2 %, $p = 0.02$), highlighting the role of emotional and social factors beyond classic biomedical determinants. Total weight gain during pregnancy showed only a weak correlation with birthweight ($r = 0.094$, $p = 0.038$) in bivariate analysis, and meeting recommended gestational weight gain ranges was not significantly associated with higher mean birthweight in this cohort. These findings indicate that while nutritional status at registration (BMI) and obstetric timing (preterm birth) are quantitatively linked to neonatal weight outcomes, non-nutritional factors such as psychosocial wellbeing also contribute meaningfully to birthweight variability in this rural population, emphasizing the multifactorial nature of fetal growth determinants in Sri Lanka(6).

Previous research in Sri Lanka has also explored how maternal anthropometry relates to adverse neonatal outcomes. In a case–control study examining risk factors for large-for-gestational-age (LGA) newborns at the Teaching Hospital Kandy, Jayalath (2022) evaluated socio-demographic and maternal measurement predictors among 44 LGA cases and 132 controls. While maternal BMI at booking visit was not statistically significant (probit coefficient 1.76; 95 % CI −0.34 to 3.85; $p > 0.05$), the analysis identified that maternal weight gain during pregnancy was a significant modifiable risk factor for delivering an LGA infant (probit coefficient 0.77; 95 % CI 0.50–1.03; $p < 0.05$), indicating that greater gestational weight gain was associated with higher likelihood of LGA births. Among socio-demographic factors, parity of two (coef. 1.89; 95 % CI 0.75–3.03; $p < 0.05$) and parity ≥3 (coef. 2.37; 95 % CI 0.92–3.82; $p < 0.05$), monthly family income >30,000 LKR (coef. 2.28; 95 % CI 0.92–3.63; $p < 0.05$), and Tamil ethnicity (coef. 2.10; 95 % CI 0.69–3.52; $p < 0.05$) were significantly associated with LGA outcomes, whereas maternal age, maternal height, and fetal sex were not significant at the 5 % level. These findings suggest that although higher booking BMI per se was not an independent predictor of excessive birthweight in this cohort, excessive gestational weight gain remained an important anthropometric factor linked to neonatal size, emphasizing the need to monitor weight gain trajectories throughout pregnancy in Sri Lanka (7).

According to a nationwide prospective cohort study in Sri Lanka to evaluate the association between gestational weight gain and low birth weight across different pre-pregnancy body mass index categories, 13.5% of newborns were classified as LBW. Furthermore, it was revealed that among underweight women (BMI <18.5 kg/m^2), each unit increase in GWG z-score significantly reduced the odds of LBW. Underweight women whose GWG was below the Institute of Medicine recommendations had more than a threefold increased risk of delivering LBW infants compared to those within the recommended range. These findings underscore the importance of tailoring antenatal nutritional interventions, particularly emphasizing adequate GWG in underweight women, to reduce the burden of LBW in Sri Lanka (8).

Justification

While some studies have addressed weight gain and maternal characteristics, few have systematically examined how pre-pregnancy BMI categories specifically impact weight gain and subsequent birth outcomes, especially in relation to the Asian population's BMI standards. Additionally, existing research often does not consider the combined effects of maternal education, socioeconomic status, age, and parity on pregnancy weight gain.

This proposed study aims to fill these gaps by providing a detailed analysis of how maternal booking visit BMI and weight gain relate to birth weight while also considering relevant socio-demographic factors. By utilizing local population data and focusing on the Asian BMI categories, the findings will offer insights that can inform public health strategies and clinical practices tailored to the Sri Lankan context.

There is scarce research conducted on the Asian population with regard to pre-pregnancy BMI and gestational weight gain referring to the BMI cutoffs recommended for the Asian populations. The ‘Committee to Reexamine IOM Pregnancy Weight Guidelines’ emphasizes the importance in conducting studies that observe the extent to which optimal GWG varies based not only by pre-pregnancy BMI of the mother but also by other factors such as the maternal age, parity, socioeconomic status, racial/ethnic group and maternal, paternal or fetal genotype. Therefore, it is a timely requirement to conduct studies to observe the association between pre-pregnancy BMI, gestational weight gain, birth weight of the baby and early neonatal outcomes in the Sri Lankan setting (9).

CHAPTER 02: LITERATURE REVIEW

Maternal health during pregnancy is critical not only for the mother's well-being but also for the newborn's health. The interplay between a mother's body mass index (BMI) during her first booking visit and the weight gain throughout her pregnancy can significantly impact birth outcomes. In Sri Lanka, particularly in the Anuradhapura District, understanding these associations is vital for improving maternal and neonatal health outcomes, as they can inform public health policies and clinical practices. The following literature was gathered from Google Scholar, PubMed, and journal articles.

Research consistently demonstrates that maternal BMI at booking significantly predicts birth weight. Enberg's study (2021) identified key risk factors for SGA(small for gestation age) infants, including maternal pre-pregnancy weight and BMI, emphasizing the need for accurate assessments of maternal health to identify at-risk pregnancies(10). The findings revealed that a pre-pregnancy weight of less than 50 kg and a BMI below 18.5 were associated with increased odds of having SGA infants, with odds ratios of 2.18 and 2.24, respectively(10). This aligns with findings from a Sri Lankan study, which indicated that low maternal weight was linked to higher rates of low birth weight (10). Also, several previous researches in Sri Lanka have indicated a correlation between maternal BMI and adverse neonatal outcomes, highlighting that both underweight and overweight mothers face increased risks(11).

Additionally, a population-based study in Qatar found that overweight and obese women faced significantly higher risks of gestational diabetes and adverse pregnancy outcomes, suggesting that both ends of the BMI spectrum, underweight and obesity, carry risks for neonatal health(12). The prevalence of obesity among young women in Sri Lanka is increasing, making it essential to monitor its impact on pregnancy outcomes, as evidenced by studies linking high BMI to complications such as pre-eclampsia and macrosomia (11). Compared with women of normal BMI, overweight women (BMI 25.0–29.9 kg/m^2) had a significantly higher risk of gestational diabetes mellitus (adjusted odds ratio [aOR] $\approx$ 1.8), while obese women (BMI $\geq$30 kg/m^2) exhibited an even greater risk (aOR $\approx$ 3.0–3.5). Obesity was also strongly associated with macrosomia (OR $\approx$ 2.1), large-for-gestational-age infants (OR $\approx$ 2.0), caesarean delivery (OR $\approx$

1.9), and hypertensive disorders of pregnancy (OR ≈ 2.2), with all associations remaining statistically significant ($p < 0.05$) after adjustment for confounders. Complementing these findings, the doctoral research by Seneviratne (2017) highlighted those overweight and obese pregnant women had a higher baseline prevalence of pregnancy complications, including pre-eclampsia and excessive gestational weight gain, and that structured antenatal exercise interventions were associated with reductions in gestational diabetes risk and improved birth weight profiles. Given the rising prevalence of overweight and obesity among women of reproductive age in Sri Lanka, these findings underscore the growing public health relevance of maternal adiposity and emphasize the importance of routine BMI assessment, gestational weight monitoring, and lifestyle-based antenatal interventions to mitigate obesity-related pregnancy complications such as pre-eclampsia and macrosomia..

Weight gain during pregnancy is another critical factor influencing birth weight. Agha et al. (2022) found that adherence to recommended weight gain guidelines based on pre-pregnancy BMI significantly correlates with healthier birth outcomes(13). Papandreou et al. (2022) demonstrated that deviation from recommended gestational weight gain (GWG) guidelines was significantly associated with adverse birth outcomes. Women who entered pregnancy with excess pre-pregnancy weight (BMI ≥ 25 kg/m^2) were more likely to experience excessive gestational weight gain, which in turn was associated with a significantly higher risk of macrosomia and large-for-gestational-age (LGA) infants, with reported odds ratios ranging from approximately 1.6 to 2.3 compared to women with normal BMI. Conversely, inadequate weight gain among women with lower or normal BMI was associated with an increased likelihood of low birth weight (LBW) and small-for-gestational-age (SGA) neonates. The study further highlighted that adherence to Institute of Medicine (IOM) weight gain recommendations was associated with more favorable birth outcomes, including optimal birth weight and reduced obstetric complications (**$p < 0.05$**). Understanding how weight gain affects birth outcomes is crucial in Sri Lanka, where nutritional status and dietary practices vary.

In the cohort study by Wijayasundara et al. (2013), socioeconomic factors, including maternal education and income level, were shown to influence weight gain patterns(14). Maternal education showed a statistically significant association with birth weight ($p < 0.05$), suggesting that limited education may adversely influence maternal nutritional practices and utilization of antenatal care services. Lower educational attainment was associated with a higher risk of LBW, as mothers with limited education often lack access to proper nutritional guidance and healthcare services. This underscores the need for public health interventions targeting education and nutrition to improve weight gain during pregnancy(14).

The relationship between maternal weight gain and neonatal outcomes is well established. Excessive weight gain is often linked to macrosomia, defined as birth weight over 4,000 grams, which can lead to complications such as birth trauma and increased risk for cesarean delivery. On the other hand, inadequate weight gain correlates with LBW and increases the risk of neonatal morbidity (15). Understanding these associations can guide interventions promoting healthy weight gain during pregnancy to optimize birth outcomes in the Sri Lankan context. In Anuradhapura District, a deeper understanding of these associations is essential for developing targeted interventions to improve maternal and neonatal health. Addressing factors such as education, socioeconomic status, and cultural practices can help health providers offer better support to pregnant women.

A systematic review and meta analysis involving over 1.3 million pregnancies identified that 47% of women exceeded and 23% fell below the recommended gestational weight gain thresholds based on prepregnancy BMI. Weight gain below the guidelines was significantly associated with increased risks of small for gestational age infants (OR 1.53) and preterm births (OR 1.70). These findings suggest that both insufficient and excessive gestational weight gain may predispose to distinct yet significant perinatal risks (16).

Rahman et al conducted a systematic review and meta analysis involving 42 studies from low and middle income countries to evaluate the association between maternal BMI and perinatal and maternal health outcomes.–Maternal pre-pregnancy body mass index (BMI), adverse maternal and birth outcomes, providing quantitative evidence of a clear U-shaped relationship. The results revealed that maternal underweight was significantly associated with an increased risk of low birth weight and small for gestational age infants. Pooled estimates showed that underweight women (BMI <18.5 kg/m^2) had a significantly increased risk of low birth weight (RR $\approx$ 1.6–1.9), small-for-gestational-age births (RR ≈ 1.5–1.8), and preterm delivery (RR ≈ 1.3–1.5) compared with women of normal BMI. In contrast, overweight and obese women (BMI ≥25 kg/m²) exhibited markedly higher risks of macrosomia (RR ≈ 1.7–2.4), large-for-gestational-age infants (RR ≈ 1.6–2.1), hypertensive disorders of pregnancy (RR ≈ 2.0–3.5), and caesarean section (RR ≈ 1.4–1.9), while the risk of gestational diabetes mellitus was approximately two- to threefold higher among obese mothers. The population attributable risk estimates indicated that 14 - 35% of adverse maternal outcomes and up to 20% of low birthweight cases could be prevented if maternal BMI were normalized. These findings emphasize the burden of under nutrition in developing regions and highlight the need for pre-pregnancy BMI optimization to improve maternal and neonatal health outcomes (17).

2.1. Objectives

2.1.1 General Objective

To describe association of maternal booking visit BMI and weight gain during pregnancy with birth weight of the baby and early neonatal outcomes, in Teaching Hospital Anuradhapura

2.1.2 Specific objectives

1. To assess the association between maternal booking visit BMI, weight gain during pregnancy, and birth weight of the baby
2. To analyze the pregnancy weight gain in relation to pre-pregnancy BMI category, referring to BMI categories pertaining to Asian population
3. To assess the associated factors to pregnancy weight gain such as educational level/ socioeconomic status, age, parity of the mother

CHAPTER 03: METHODOLOGY

3.1 Study design

Observational cross-sectional study

3.2 Study setting

The study was taken place in the postnatal wards of Teaching Hospital Anuradhapura, Sri Lanka, where systematic sampling was utilized to ensure efficient participant selection from a well-defined list of postnatal mothers, thereby facilitating representativeness and minimizing selection bias within the diverse population of 440 eligible mothers.

3.3 Study period

Study was conducted over a period of 2 months.

3.4 Study sample

Postnatal mothers who had uncomplicated singleton pregnancies who were confined at term (>37 weeks of POA).

3.4.1 Sample size calculation

The minimum sample size required in a cross-sectional study will be calculated using the following formula (Lwanga et al., 1991).

$n=(Z\,\alpha/ 2)^{2} \times P(1-P)/ d^2$

n is the required sample size

$Z\,\alpha/ 2 = 1.96$ (at 95% confidence interval)

P is the expected proportion (There was no previous studies in this context. So expected population proportion was taken as 50 %

d=precision considered as 0.05

$n= 1.96\times1.96 \times (0.5\times (1 - 0.5))/ (0.05\times0.05)$

n= 384

If non responders' rate is 10%, n=384/0.9

Required Sample size(minimum)= 423

3.5 Study population

Pregnant women who delivered their babies in Teaching Hospital Anuradhapura was considered as the study population.

3.5.1 Inclusion criteria

- Gestational age more than 37 weeks of gestation
- Singleton pregnancies

3.5.2 Exclusion criteria

- Postnatal mothers who had complicated with medical disorders during pregnancy
- Post natal mothers who experience and treated antepartum Haemorrages during pregancy period
- Mother who has diagnosed Placental abnormalities.

3.6 Sampling technique

A systematic random sampling technique was used to select study participants. Postnatal ward admission list was used as the sampling frame. The starting point was selected randomly from the first 10 patients in the admission list on each day and from there onwards every other patient was recruited into the study provided that they fulfill the eligibility criteria.

3.7 Consent

The eligible participants were selected from the postnatal wards and informed verbal consent

was obtained from all potential participants by intern medical officers at the postnatal wards at Teaching Hospital Anuradhapura.
The investigators introduced themselves and informed the participants about the study verbally. The study participants were clearly informed that none of their identification details were collected for research purposes, and all gathered data were kept anonymous under lock and key with the investigators.

3.8 Data collection

The data collection of the study was carried from the consented individuals at the postnatal wards. Data collection for the study was conducted by a team of trained data collectors, comprising intern house officers, nursing officers, who are individuals with backgrounds in nursing and public health. Each data collector holds at least a bachelor's degree in a relevant field and has prior experience in maternal and child health research. Before the study begins, all data collectors undergo a standardized training program to ensure consistency in data collection methods, ethical considerations, and effective interviewing techniques. The team was proficient in both Sinhala and Tamil, allowing them to communicate effectively with the diverse population of postnatal mothers in the wards. This linguistic capability facilitated accurate and meaningful interactions during the data collection process.

3.9. Study instrument

The structured interviewer administered datasheet was used to collect socio-demographic and medical data by interviewing the mother and referring to data on bed head tickets, medical records, Antenatal Care Records, Delivery Records, Postnatal Care Records, Growth and Development Charts (Annex 1)

The prepared data collection sheet was sent to 5 field experts. Based on the comments received, the data collection sheet was revised. The revised data sheet was first translated into Tamil and English. Then it was translated back from English and Tamil to Sinhala. The translated data sheet was compared with the original data sheet to ensure accuracy. Standard language translators were used for this translation task and attention was paid to using common language words rather than technical words. The finalized data collection sheet was pretested using an individual sample of the same study population in the same study setting. 15 participants were used for this. The way the questions were understood and the time taken by an individual to answer the questionnaire completely were considered. After that, the necessary revisions were made and the final questionnaire was prepared.

3.10. Data Analysis

All collected data was entered into excel 2021 data sheet. Then it was converted into SPSS spreadsheet for analysis. Data analysis was facilitated by SPSS version 28.0. All categorical variables were described by using frequencies and percentages. Continuous variables were described by using mean and standard deviations. Chi square test was used to establish associations between categorical variables. Pearson's correlation coefficient was used to establish associations between continuous variables. Relevant regression models were used to established between categorical continuous variables. Predictive associations were established by using Receiver Operative Characteristics curve. 0.05 probability cut off and 95% confidence interval were used to determine statistical significance.

3.11. Dissemination of the results

The results of the study will be disseminated through peer reviewed forums and will be published in high impact factor international journals and local and international scientific conferences.

3.12. Benefits/Risk

No identifiable risks associated with this study.
The findings will be useful in improving the understanding about the patterns of weight gain during pregnancy in the Sri Lankan population. With the neonatal birthweight and the early neonatal outcome it will be useful in building local guidelines in weight gain during pregnancy according to Asian BMI categories as the currently used are the IOM guidelines which were amended in 2009 by the Institute of Medicine and National Research Council. The scientific community will benefit as this research will be the basis for many future studies.

3.13. Ethical Consideration

Only the participants who consent were recruited for the study. The data were utilized to its maximum potential in order to provide useful recommendations.
All the data will be kept for 2 years, after which they will be destroyed preventing access to them by unauthorized persons. All paper-based data were kept under lock and key in a secure filing cabinet with access only for the investigators, and all electronic data were stored in a dedicated computer for this study secured with a password.
The anonymity of the patients were protected. Ethical approval for the study was obtained from Rajarata University of Sri Lanka.

CHAPTER 04: RESULTS

The total sample size was 440. The study took place in the postnatal wards of Teaching Hospital Anuradhapura, Sri Lanka. Systematic sampling was used to select participants from a defined list of eligible postnatal mothers, ensuring representativeness and minimizing selection bias within the diverse population. Association of maternal booking visits BMI and weight gain during pregnancy with weight of the baby and early neonatal diagnosis was assessed in this study.

Table 1: Distribution of age occupation and ethnicity of study participants.

Factors	Frequency (%)
Maternal age (Mean ± SD) (Years) (n=440)	28.45 ± 5.78
Occupation (n=440)	
Employed	117 (26.6)
Unemployed	323 (73.4)
Ethnicity (n=440)	
Sinhala	409 (93.0)
Muslim	31 (7.0)

Table 1 presents the demographic characteristics of the study population. The mean maternal age was 28.45 years with a standard deviation of 5.78 years (n=440). Regarding occupation, the majority of the participants were unemployed, accounting for 323 (73.4%) of the sample, while 117 (26.6%) were employed. In terms of ethnicity, most of the mothers were Sinhala, comprising 409 (93.0%) of the total sample, whereas 31 (7.0%) were Muslim.

Table 2: Distribution of Parity and gravida of study participants

Parity and gravida	Frequency (%)
Gravidity (n=440)	
<3	317 (72.0)
>3	123 (28.0)
Parity (n=440)	
<3	352 (80.0)
>3	88 (20.0)
Child (n=440)	
<3	371 (84.3)
>3	69 (15.7)

Table 2 summarizes the distribution of parity and gravida among the study participants. Out of 440 mothers, 317 (72.0%) had a gravida count of less than 3, while 123 (28.0%) had a gravida count greater than 3. In terms of parity, 352 (80.0%) had fewer than 3 previous deliveries, whereas 88 (20.0%) had more than 3. Regarding the number of living children, 371 (84.3%) had fewer than 3 children, while 69 (15.7%) had more than 3 children.

Table 3: Distribution of Past medical history among study participants

Past medical history	Frequency (%) (n=440)
Bronchial Asthma	11 (2.5)
Thalassemia Trait	9 (2.0)
Unremarkable	397 (90.2)
Others	23 (5.2)

Table 3 presents the past medical history of the study participants. Among the 440 mothers, the majority, 397 (90.2%), had an unremarkable medical history. Bronchial asthma was reported in 11 (2.5%) participants, while 9 (2.0%) had a history of thalassemia trait. Additionally, 23 (5.2%) mothers had other medical conditions not specified in the listed categories.

Table 4: Distribution of detection of Anemia among study participants

Anaemia	Frequency (%) (n=440)
Yes	26 (5.9)
No	414 (94.1)

Table 4 summarizes the prevalence of anemia among the study participants. Out of 440 mothers, 26 (5.9%) were identified as having anaemia, while the remaining 414 (94.1%) did not have anaemia.

Table 5:Distribtion of Dietary History of Study Participants

Diet history	Frequency (%) (n=440)
Vegan	41 (9.3)
Vegetarian	20 (4.5)
Lacto-ovo-vegetarian	1 (0.2)
Omnivore	378 (85.9)

Table 5 summarizes the dietary history of the study participants. Among the 440 mothers, the majority, 378 (85.9%), followed an omnivorous diet. A total of 41 participants (9.3%) identified as vegan, while 20 (4.5%) reported being vegetarian. Only 1 participant (0.2%) followed a lacto-ovo-vegetarian diet.

Table 6: Distribution of Anthropometric measurements among study participants

Variables	Mean ± SD (n=440)
Booking visit weight (kg)	54.87 ± 11.13
Booking visit height (cm)	154.75 ± 6.10
Booking visit BMI (kg/m2)	22.92 ± 4.49
Weight at confinement (kg)	65.68 ± 11.53
Weight gain (kg)	10.81 ± 4.80

Table 6 presents the anthropometric measurements of the study participants. The mean weight at the booking visit was 54.87 kg with a standard deviation (SD) of 11.13 kg. The mean height recorded at the booking visit was 154.75 cm (SD ± 6.10). The corresponding mean Body Mass Index (BMI) at the booking visit was 22.92 kg/m² with an SD of 4.49. By the time of confinement, the mean maternal weight had increased to 65.68 kg (SD ± 11.53), resulting in a mean weight gain during pregnancy of 10.81 kg with a standard deviation of 4.80 kg.

Table 7: Distribution of Body Mass Index (BMI) among study participants at booking visit

Body Mass Index (kg/m2)	Frequency (%) (n=440) Booking visit BMI
Underweight (<18.5 kg/m2)	72 (16.4)
Normal weight (18.5-22.9 kg/m2)	229 (52.0)
Overweight (23.0-27.5 kg/m2)	112 (25.5)
Obese (>27.5 kg/m2)	27 (6.1)

Table 7 summarizes the distribution of Body Mass Index (BMI) among the study participants at the booking visit. At the booking visit, 72 mothers (16.4%) were under weight, 229 (52.0%) had a normal BMI, 112 (25.5%) were overweight, and 27 (6.1%) were obese.

Table 8: Distribution of Mode of delivery among study participants

Factors	Frequency (%) (n=440)
Emergency Lower Segment Caesarean Section	73 (16.6)
Elective Lower Segment Cesarean Section	105 (23.9)
Normal vaginal delivery	257 (58.4)
Vacuum delivery	5 (1.1)

Table 8 presents the mode of delivery among the study participants. Out of 440 mothers, the majority, 257 (58.4%), had a normal vaginal delivery. Elective cesarean section was performed in 105 cases (23.9%), while 73 mothers (16.6%) underwent an emergency lower segment cesarean section. Additionally, 5 deliveries (1.1%) were assisted using vacuum extraction.

Table 9: Distribution of Demographic characteristics of newborns

Factors	Frequency (%)
Birth weight (Mean ± SD) (n=440)	2.98 ± 0.43
Baby Gender (n=440)	
Male	272 (61.8)
Female	168 (38.2)
Fetal problems identified during pregnancy (n=440)	
Fetal Growth Restriction (FGR)	7 (1.6)
Other*	7 (1.6)
No	426 (96.8)

Other*- pyelectasis, hydrocephalus

Table 9 summarizes the demographic characteristics of the newborns. The mean birth weight was 2.98 kg with a standard deviation of 0.43 kg (n=440). Among the newborns, 272 (61.8%) were male and 168 (38.2%) were female. Regarding fetal problems identified during pregnancy, 7 newborns (1.6%) had Fetal Growth Restriction (FGR), another 7 (1.6%) had other types of fetal issues, while the majority, 426 (96.8%), had no identified fetal problems.

Table 10: APGAR scores and neonatal outcomes among new born

Factors	Frequency (%)
APGAR Score (Mean ± SD) (n=440)	
APGAR score at first assessment	9.01 ± 0.654
APGAR score at the second assessment	9.87 ± 0.735
APGAR score at the third assessment	9.94 ± 0.29
Needed PBU care (n=440)	
Yes	18 (4.1)
No	422 (95.9)
If yes cause (n=18)	
Premature	5 (27.8)
Grunting	4 (22.2)
Other*	9 (50.0)
Outcome (n=440)	
Direct discharged from the ward	422 (95.9)
Discharged after PBU care	18 (4.1)

*PBU: Premature baby unit

Table 10 presents the APGAR scores and neonatal outcomes of the study population. The mean APGAR score at the first assessment was 9.01 (± 0.654), at the second assessment was 9.87 (± 0.735), and at the third assessment was 9.94 (± 0.29). Out of 440 newborns, 18 (4.1%) required admission to the Premature Baby Unit (PBU), while the majority, 422 (95.9%), did not. Among those who required PBU care (n=18), 5 (27.8%) were admitted due to prematurity, 4 (22.2%) due to grunting, and 9 (50.0%) for other causes. In terms of final outcomes, 422 (95.9%) babies were directly discharged from the ward, whereas 18 (4.1%) were discharged following care in the PBU.

Table 11: Association between outcome of pregnancy and demographic factors

Demographic factors	Outcome		P Value
	Discharged without PBU care (n=422)	Discharged after PBU care (n=18)	
Maternal Age (Years)	28.53 ± 5.76	26.50 ± 5.90	P=0.266
Ethnicity			
Sinhala	391 (92.7)	18 (100.0)	$\chi 2$=1.422 df=1 P=0.628*
Muslim	31 (7.3)	0 (0.0)	
Occupation			
Employed	114 (27.0)	3 (16.7)	$\chi 2$=0.947 df=1 P=0.423*
Unemployed	308 (73.0)	15 (83.3)	

*Fisher's exact value

Table 11 summarizes the association between the outcome of pregnancy and selected demographic factors. The mean maternal age among those whose babies were directly discharged was 28.53 ± 5.76 years, while it was slightly lower at 26.50 ± 5.90 years for those whose babies required PBU care, though the difference was not statistically significant (P=0.266). In terms of ethnicity, all 18 babies who required PBU care were born to Sinhala mothers (100.0%), while among those directly discharged, 391 (92.7%) were Sinhala and 31 (7.3%) were Muslim. This association was not statistically significant (P=0.628). Regarding maternal occupation, 3 (16.7%) of the mothers whose babies required PBU care were employed and 15 (83.3%) were unemployed. Among mothers of babies who were directly discharged, 114 (27.0%) were employed and 308 (73.0%) were unemployed. This difference was also not statistically significant (P=0.423).

Table 12: Association between Outcome and Parity and Gravida

Parity and Gravida	Outcome		P Value
	Discharged without PBU care (n=422)	Discharged after PBU care (n=18)	
Gravida			
<3	303 (71.8)	14 (77.8)	$\chi2$=0.306 df=1 P=0.790*
>3	119 (28.2)	4 (22.2)	
Parity			
<3	334 (79.1)	18 (100.0)	$\chi2$=4.692 df=1 **P=0.031***
>3	88 (20.9)	0 (0.0)	
Child			
<3	353 (83.6)	18 (100.0)	$\chi2$=3.491 df=1 P=0.090*
>3	69 (16.4)	0 (0.0)	

*Fisher's exact value

Table 12 presents the association between pregnancy outcomes and maternal parity and gravida. Among the 422 mothers whose babies were directly discharged, 303 (71.8%) had a gravida count less than 3, while 119 (28.2%) had a gravida count greater than 3. In the group whose babies required PBU care (n=18), 14 (77.8%) had a gravida count less than 3 and 4 (22.2%) had a gravida count greater than 3. This association was not statistically significant (P=0.790).

For parity, all 18 mothers whose babies required PBU care had a parity less than 3 (100.0%), while among those whose babies were directly discharged, 334 (79.1%) had parity less than 3 and 88 (20.9%) had parity greater than 3. This association was statistically significant (P=0.031).

Regarding the number of children, 353 (83.6%) mothers with directly discharged babies had fewer than 3 children, compared to 18 (100.0%) in the PBU care group. A total of 69 (16.4%) mothers with directly discharged babies had more than 3 children, while none in the PBU group did. This difference was not statistically significant (P=0.090).

Table 13: Association between Outcome and Past Medical history

Past medical history	Outcome	
	Discharged without PBU care (n=422)	Discharged after PBU care (n=18)
Bronchial Asthma	11 (2.6)	0 (0.0)
Thalassemia Trait	8 (1.9)	1 (5.6)
Unremarkable	381 (90.3)	16 (88.9)
Other	22 (5.2)	1 (5.6)

Table 13 presents the association between neonatal outcome and the maternal past medical history. Among the mothers whose babies were directly discharged (n=422), 11 (2.6%) had a history of bronchial asthma, 8 (1.9%) had thalassemia trait, 381 (90.3%) had an unremarkable medical history, and 22 (5.2%) had other medical conditions. In the group of mothers whose babies required PBU care (n=18), none had bronchial asthma, 1 (5.6%) had thalassemia trait, 16 (88.9%) had unremarkable histories, and 1 (5.6%) had other medical conditions.

Table 14: Association between Outcome and anemia

Anemia	Outcome		P Value
	Discharged without PBU care (n = 422)	Discharged after PBU care (n = 18)	
Yes	25 (5.9)	1 (5.6)	χ^2=0.004 df=1 P=1.000*
No	397 (94.1)	17 (94.4)	

*Fisher's exact value

Table 14 summarizes the association between maternal anemia and neonatal outcome. Among the mothers whose babies were directly discharged (n=422), 25 (5.9%) had anemia, while 397 (94.1%) did not. In the group whose babies required PBU care (n=18), 1 mother (5.6%) had anemia and 17 (94.4%) did not. The association between maternal anemia and neonatal outcome was not statistically significant (P=1.000).

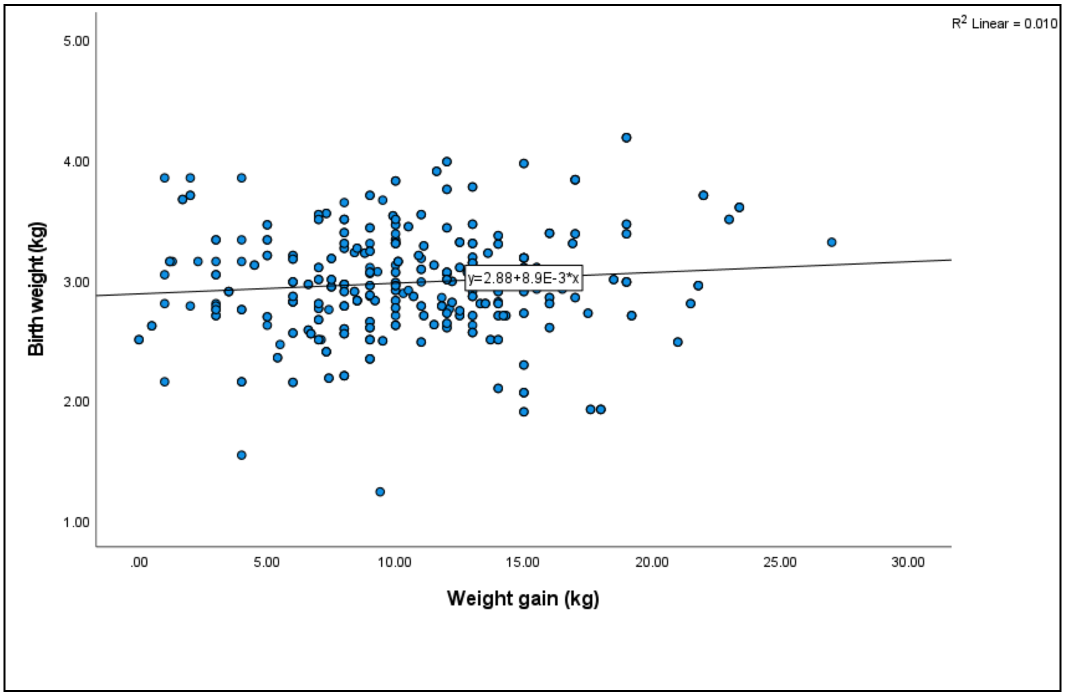


Figure 1: Scatter plot demonstrating the distribution of associations between weight gain and birth weight

Figure 1 illustrates a scatter plot demonstrating the distribution of associations between maternal weight gain and birth weight. The scatter plot shows a positive linear relationship, and the correlation coefficient (R value) is 0.084. The association is not statistically significant, with a p-value of 0.077.

Table 15: Association between weight gain and various demographic factors,

Factor	Weight gain (Mean ± SD)	P value
Maternal Age	-	**<0.001**
Ethnicity		
Sinhala	10.82 ± 4.74	0.957
Muslim	10.68 ± 5.50	
Occupation		
Employed	11.72 ± 4.81	**0.004**
Unemployed	10.48 ± 4.75	

Table 15 summarizes the association between weight gain during pregnancy and various demographic factors. A statistically significant association was observed between maternal age and weight gain with a P value of 0.001. When analyzed by ethnicity, Sinhala mothers had a mean weight gain of 10.82 ± 4.74 kg, while Muslim mothers had a mean weight gain of 10.68 ± 5.50 kg, with no statistically significant difference between the groups (P = 0.957). Regarding occupation, employed mothers had a higher mean weight gain of 11.72 ± 4.81 kg compared to unemployed mothers, who had a mean weight gain of 10.48 ± 4.75 kg. This difference was statistically significant (P = 0.004).

Table 16: Associations of weight gain and birth weight with diet history

	Diet history			P Value
	Vegan	Vegetarian	Omnivore	
Weight gain	9.5 ± 5.43	8.77 ± 3.43	11.06 ± 4.748	0.039
Birth weight	3.08±0.428	2.89±0.426	2.96±0.435	0.172

Table 16 shows the associations between maternal diet history and two outcomes: weight gain during pregnancy and birth weight of the baby. The mean weight gain among vegan mothers was 9.5 ± 5.43 kg, among vegetarians was 8.77 ± 3.43 kg, and among omnivores was 11.06 ± 4.75 kg. This difference in weight gain was statistically significant, with a p-value of 0.039. Regarding birth weight, the mean for babies born to vegan mothers was 3.08 ± 0.43 kg, for vegetarians was 2.89 ± 0.43 kg, and for omnivores was 2.96 ± 0.44 kg. However, the variation in birth weight among the different dietary groups was not statistically significant, with a p-value of 0.172.

Table 17: Association between weight gain and Parity and Gravidity

Factor	Weight gain (Mean ± SD)	P value
Gravida		
<3	11.17 ± 4.98	**0.012**
>3	9.89 ± 4.17	
Parity		
<3	11.08 ± 4.97	**0.006**
>3	9.74 ± 3.84	
Children		
<3	11.03 ± 4.89	**0.018**
>3	9.66 ± 4.10	

Table 17 summarizes the association between weight gain during pregnancy and parity and gravida. Mothers with a gravida count less than 3 had a mean weight gain of 11.17 ± 4.98 kg, while those with a gravida count greater than 3 had a lower mean weight gain of 9.89 ± 4.17 kg, with the difference being statistically significant (P = 0.012). Similarly, mothers with a parity less than 3 had a higher mean weight gain of 11.08 ± 4.97 kg compared to 9.74 ± 3.84 kg in those with parity greater than 3 (P = 0.006). Regarding the number of children, mothers with fewer than 3 children had a mean weight gain of 11.03 ± 4.89 kg, whereas those with more than 3 children had a mean weight gain of 9.66 ± 4.10 kg. This association was also statistically significant (P = 0.018).

Table 18: Association between weight gain and Past medical history

Past medical history	Weight gain (Mean ± SD)	P value
Bronchial Asthma	8.65 ± 1.75	0.236
Thalassemia Trait	11.42 ± 4.57	
Unremarkable	10.89 ± 4.81	
Other	10.26 ± 5.44	

Table 18 presents the association between weight gain during pregnancy and past medical history. Mothers with a history of bronchial asthma had a mean weight gain of 8.65 ± 1.75 kg. Those with thalassemia trait had a mean weight gain of 11.42 ± 4.57 kg. Mothers with a unremarkable medical history had a mean weight gain of 10.89 ± 4.81 kg, while those with other medical conditions had a mean weight gain of 10.26 ± 5.44 kg. The observed differences in weight gain across these groups were not statistically significant (P = 0.236).

Table 19: Association between weight gain and anemia

Anemia	Weight gain (Mean ± SD)	P value
Yes	12.24 ± 5.65	0.137
No	10.72 ± 4.73	

Table 19 summarizes the association between maternal anemia and weight gain during pregnancy. Mothers with anemia had a mean weight gain of 12.24 ± 5.65 kg, while those without anemia had a mean weight gain of 10.72 ± 4.73 kg. This difference was not statistically significant (P = 0.137).

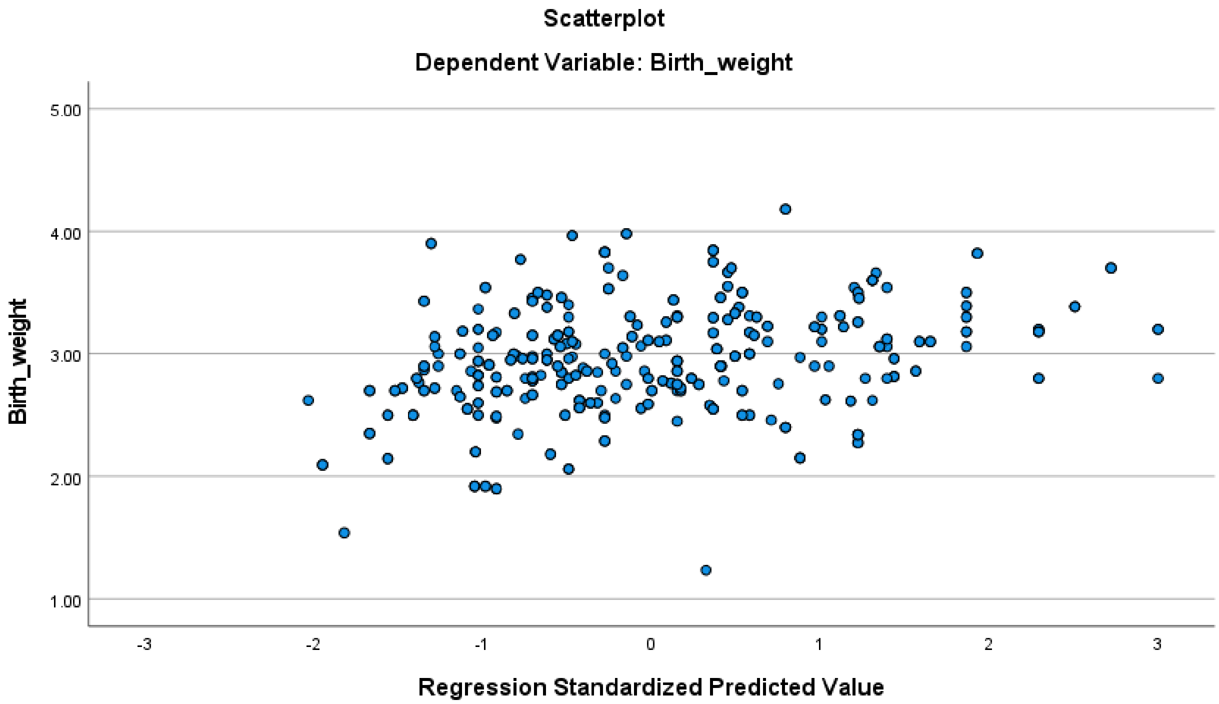
Table 20: Association between weight gain and dietary history

Diet history	Weight gain (Mean ± SD)	P value
Vegan	9.50 ± 5.43	**0.039**
Vegetarian	8.78 ± 3.43	
Lacto-ovo-vegetarian	-	
Omnivore	11.06 ± 4.75	

Table 20 presents the association between maternal dietary history and weight gain during pregnancy. Mothers following a vegan diet had a mean weight gain of 9.50 ± 5.43 kg, while those who were vegetarian had a mean weight gain of 8.78 ± 3.43 kg. No mean value was recorded for lacto-ovo-vegetarians due to a single participant. Mothers with an omnivorous diet had a higher mean weight gain of 11.06 ± 4.75 kg. The association between dietary pattern and weight gain was statistically significant (P = 0.039).

Association between Maternal weight gain and Booking visit Body Mass Index with the birth weight of the baby

Figure 2 : Booking visit BMI with Birth weight of the baby



Regression standardized predictive value was considered as x axis and birth weight was considered as y axis in figure 2. Body mass Index at the booking visit of the mother is significantly associated with birth weight of the baby (Regression coefficient=0.305: t=6.69:p<0.001). According to Pearson's correlation coefficient evaluation Body mass Index at booking visit and birth weight are significantly correlated (Pearson's correlation co efficient=0.305: p<0.001:95% CI=0.02-0.037).

CHAPTER 05: DISCUSSION

This study examined the association between maternal booking visit BMI, gestational weight gain, birth weight, and early neonatal outcomes in the Anuradhapura district of Sri Lanka. The findings provide insight into maternal nutritional status, demographic characteristics, and their relationship with neonatal outcomes in a rural Sri Lankan setting.

Maternal Demographic and Socioeconomic Characteristics

The study population consisted predominantly of young women (mean age 28.45 ± 5.78 years), with most having fewer than three pregnancies (72%) and parity below three (80%). The majority lived in households with fewer than three children (84.3%), reflecting contemporary reproductive trends toward smaller family sizes. Smaller family units may allow improved allocation of resources and maternal attention per child, potentially contributing to favourable maternal and neonatal outcomes.

A considerable proportion of participants were unemployed (73.4%), indicating potential socioeconomic vulnerability. Employment status showed a statistically significant association with gestational weight gain, with employed mothers gaining more weight than unemployed mothers (11.72 ± 4.81 kg vs. 10.48 ± 4.75 kg; $p = 0.004$). This may reflect differences in household income, food accessibility, or autonomy in dietary decisions. The ethnic distribution was predominantly Sinhala (93%), representing the demographic pattern of the study area.

Maternal Health and Anthropometric Profile

Most participants (90.2%) reported no significant past medical history. Conditions such as bronchial asthma (2.5%) and thalassemia trait (2%) were present in small proportions. No significant association was observed between past medical history and gestational weight gain ($p = 0.236$). The mean booking BMI was 22.92 ± 4.49 kg/m^2, within the normal range. However, 16.4% were underweight (BMI <18.5 kg/m²), 25.5% were overweight, and 6.1% were obese (BMI >27.5 kg/m²). Mean maternal weight increased from 54.87 ± 11.13 kg at booking to 65.68 ± 11.53 kg at confinement, indicating an average gestational weight gain of approximately 10.8 kg.

Higher booking BMI was inversely associated with weight gain in regression analysis, suggesting that women with elevated BMI at baseline gained comparatively less weight during pregnancy. This may reflect clinical counselling to restrict excessive weight gain among overweight and obese mothers.

Dietary Patterns and Weight Gain

The majority of mothers followed an omnivorous diet (85.9%), while 9.3% were vegan and 4.5% vegetarian. Dietary pattern showed a statistically significant association with gestational weight gain ($p = 0.039$), with omnivorous mothers demonstrating higher weight gain. However, dietary pattern did not significantly influence birth weight in this cohort. These findings suggest that while dietary practices affect maternal weight trajectories, they may not independently determine neonatal weight when overall nutritional adequacy is maintained.

Gestational Weight Gain and Birth Weight

The mean birth weight was 2.98 ± 0.43 kg, within the normal range. Low birth weight and fetal growth restriction were observed in a small proportion (1.6%). Although maternal weight gain demonstrated a positive correlation with birth weight ($r = 0.084$), this association did not reach statistical significance ($p = 0.077$). This finding contrasts with extensive global literature indicating that appropriate gestational weight gain is a strong determinant of optimal fetal growth. However, the relatively weak correlation observed in this study suggests that, in this population, birth weight may be influenced by additional factors beyond maternal weight gain alone, including genetic, placental, and environmental determinants. Regression analysis demonstrated a strong positive association between maternal weight gain and birth weight, reinforcing the biological plausibility that maternal nutritional status contributes to fetal growth.

Nonetheless, the absence of statistical significance in bivariate analysis indicates that weight gain alone may not be a sufficient predictor of neonatal size in this setting.

Gravidity, Parity, and Weight Gain

Significant negative associations were identified between gravidity ($p = 0.012$), parity ($p = 0.006$), number of children ($p = 0.018$), and maternal weight gain. Women with fewer pregnancies and lower parity exhibited greater gestational weight gain. This may reflect increased maternal attention, better nutritional allocation, or reduced household responsibilities in smaller families.

Parity also showed a significant association with neonatal PBU admission ($p = 0.031$). All mothers whose neonates required PBU care had parity below three. This aligns with international evidence suggesting multiparity may be associated with reduced risks of adverse neonatal outcomes compared with nulliparity.

Neonatal Outcomes and PBU Admission

Overall neonatal outcomes were favourable. The mean APGAR score at the third assessment was 9.94 ± 0.29, indicating excellent neonatal adaptation. Although 18 neonates required PBU admission, the majority (95.9%) did not require specialized neonatal care. Maternal age, ethnicity, employment status, antenatal history, and anaemia were not significantly associated with PBU admission. The lack of association between anaemia and neonatal care requirements may reflect effective antenatal screening and management within the public health system.

Integrated Interpretation

The findings suggest that maternal anthropometric status at booking and sociodemographic factors influence gestational weight gain patterns; however, the direct impact of weight gain on birth weight was modest in this cohort. While a positive relationship between maternal weight gain and neonatal weight was observed, it did not achieve statistical significance in univariate analysis, indicating that fetal growth is multifactorial. Importantly, both low and high BMI categories were present within the population, highlighting the coexistence of undernutrition and overnutrition. These dual burdens emphasize the need for individualized antenatal nutritional counselling based on booking BMI.

Implications for Practice and Future Research

The results support strengthening BMI-based gestational weight monitoring within routine antenatal care. Interventions should particularly target unemployed women and those with lower parity who demonstrated differential weight gain patterns. Future longitudinal research across diverse Sri Lankan regions is warranted to examine long-term maternal and child health outcomes related to pre-pregnancy BMI and gestational weight gain. Such studies would clarify causal pathways and inform context-specific nutritional guidelines.

LIMITATIONS

The research has several limitations that should be noted. First, the study is confined to postnatal mothers at a single hospital, which may not reflect the broader population in Sri Lanka, potentially affecting the generalizability of the findings. Additionally, the dependence on self-reported data for dietary habits may introduce recall bias, compromising the accuracy of the information collected. The exclusion of postnatal mothers with complicated pregnancies limits the comprehensiveness of the findings, as important influencing factors may be overlooked. Furthermore, the cross-sectional design captures data at a single point in time, making it challenging to establish causal relationships between variables. Lastly, the exclusion of participants without clear documentation on pre-pregnancy BMI and weight gain may result in the loss of relevant data, thereby impacting the overall analysis and conclusions drawn from the study.

CONCLUSION AND RECOMMENDATION

Conclusions

- A significant association was found between maternal weight gain during pregnancy and birth weight of the child.
- Maternal weight gain showed a significant positive association with maternal age, employment status and diet history contrary to the negative association with gravidity, parity and children count.
- No statistically significant associations were found between neonatal outcomes and maternal age ($p = 0.266$), occupation ($p = 0.423$) or anemia status ($p = 1.000$).
- However, parity was significantly associated with neonatal outcome ($p = 0.031$) with all neonates requiring PBU care were born to mothers with parity less than 3.

Recommendations

- Targeted public health initiatives should be implemented to address the nutritional needs of pregnant women, particularly in lower-income households.
- Educational programs emphasizing balanced diets and healthy weight gain during pregnancy should be prioritized.
- Future research should focus on longitudinal studies to better understand the long-term impacts of maternal BMI and weight gain on child health across diverse populations in Sri Lanka, taking Asian BMI cut-offs into consideration.

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Annexure 1

Annexure 1- Data collection sheet

Association of maternal booking visit BMI and weight gain during pregnancy with birth weight of the baby and early neonatal outcomes, in Anuradhapura district Sri Lanka

<u>Data collection sheet</u>

Serial NO:

Maternal Age:

Occupation:

Parity and gravida:

Ethnicity:

Type of pregnancy (singleton/ multiple):

Past medical history:

Antenatal history:

GDM -

PIH -

Anaemia -

Diet history: Vegan/vegetarian/ lacto-ovo-vegetarian/omnivore

Booking visit weight: height:

Booking visit BMI:

Weight at confinement:

Mode of delivery:

Birth weight:

Foetal problems identified during pregnancy:

Early neonatal status:

APGAR score:

Needed PBU care ? : Yes/No

If yes cause: Outcome:

Annexure 2

1990 IOM guidelines for weight gain and rate of weight gain during pregnancy for women with singleton fetuses[a]

Prepregnancy weight-for-height category	Mothers of singletons	
	Total weight gain (lb)	**Rate of weight gain in the second and third trimesters (lb/wk)**
Low (BMI[a] < 19.8 kg/m^2)	28–40	~ 1.0 (0.5 kg/wk)
Normal (19.8–26.0 kg/m^2)	25–35	1.0 (0.4 kg/wk)
High (>26.0–29.0 kg/m^2)	15–25	0.66 (0.3 kg/wk)
Obese (≥ 29.0 kg/m^2)	≥ 15	Not specified

Annexure 3

New Recommendations for Total and Rate of Weight Gain During Pregnancy, by Prepregnancy BMI

Prepregnancy BMI	Total Weight Gain		Rates of Weight Gain* 2nd and 3rd Trimester	
	Range in kg	Range in lbs	Mean (range) in kg/week	Mean (range) in lbs/week
Underweight (< 18.5 kg/m2)	12.5-18	28-40	0.51 (0.44-0.58)	1 (1-1.3)
Normal weight (18.5-24.9 kg/m2)	11.5-16	25-35	0.42 (0.35-0.50)	1 (0.8-1)
Overweight (25.0-29.9 kg/m2)	7-11.5	15-25	0.28 (0.23-0.33)	0.6 (0.5-0.7)
Obese (≥ 30.0 kg/m2)	5-9	11-20	0.22 (0.17-0.27)	0.5 (0.4-0.6)