



“MATERNAL DETERMINANTS AND BIRTH WEIGHT OUTCOMES IN A TERTIARY CARE HOSPITAL OF NORTHERN MAHARASHTRA: A RETROSPECTIVE OBSERVATIONAL STUDY”

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Abstract

Background: Low birth weight (LBW) remains a major public health challenge in developing countries and is a leading contributor to neonatal morbidity and mortality. Maternal nutritional status, socio-demographic profile, and obstetric factors play a critical role in determining fetal growth and birth outcomes. Understanding these determinants in resource-limited settings is essential for improving maternal and neonatal health outcomes.

Objectives: To assess the association between maternal socio-demographic, obstetric, and nutritional factors and the birth weight of neonates delivered at a tertiary care center in Northern Maharashtra.

Methods: A retrospective observational study was conducted using delivery records of women who delivered at a tertiary health care institute in Northern Maharashtra between January 2021 and July 2021. A total of 523 mother–neonate pairs fulfilling inclusion criteria were analyzed. Data regarding maternal age, gravidity, gestational age, mode of delivery, and neonatal birth weight were collected from hospital records. Descriptive statistical analysis was performed to evaluate the relationship between maternal factors and neonatal birth weight.

Results: Out of 524 deliveries, 523 (99.8%) were live births with an average birth weight of 2.53 kg. Caesarean section accounted for 51.7% of deliveries. Birth weight increased progressively with gestational age, with extremely low birth weight observed in deliveries before 28 weeks of gestation. Higher rates of caesarean delivery were noted among low birth weight neonates. Maternal age

between 21–30 years and term gestation were associated with higher average birth weights. The incidence of stillbirth was low (0.2%), reflecting effective high-risk obstetric care.

Conclusion: Maternal and obstetric factors, particularly gestational age and mode of delivery, significantly influence neonatal birth weight. Although the study population largely represented socio-economically disadvantaged groups, appropriate tertiary care and neonatal support contributed to favorable outcomes. Strengthening antenatal care and maternal nutrition can further reduce the burden of low birth weight.

Keywords: Birth weight; Caesarean section; Gestational age; Low birth weight; Maternal factors; Neonatal outcomes; Tertiary care hospital

INTRODUCTION

Birth weight is a crucial determinant of neonatal survival, growth, and long-term health outcomes. Low birth weight (LBW), defined by the World Health Organization (WHO) as a birth weight of less than 2.5 kg irrespective of gestational age, continues to be a significant public health concern, particularly in low- and middle-income countries.¹ India alone contributes nearly one-third of the global burden of low birth weight infants, reflecting persistent inequalities in maternal nutrition, health care access, and socioeconomic status.²

Maternal health and nutritional status during pregnancy play a pivotal role in fetal growth and development. Factors such as maternal age, parity, pre-pregnancy body mass index, anemia, inter-pregnancy interval, and antenatal care utilization have been consistently associated with adverse birth outcomes.^{3–5} Inadequate maternal nutrition, particularly iron deficiency anemia and protein-energy malnutrition, compromises placental function and fetal nutrient supply, resulting in intrauterine growth restriction (IUGR), preterm birth, and low birth weight.⁶

Socioeconomic determinants further influence maternal and neonatal outcomes. Women belonging to lower socioeconomic strata often face challenges such as food insecurity, poor sanitation, limited access to quality antenatal care, and increased exposure to infections, all of which adversely affect pregnancy outcomes.⁷ Studies from rural and tribal regions of India have reported higher prevalence of LBW due to compounded effects of poverty, illiteracy, and delayed health-seeking behavior.⁸ Despite national programs targeting maternal and child health, disparities persist across regions and health-care settings.⁹

Mode of delivery has also been shown to be associated with birth weight and neonatal outcomes. Several studies indicate a higher incidence of caesarean section among low birth weight and preterm neonates, often due to fetal distress, maternal complications, or referral of high-risk pregnancies to tertiary care centers.^{10–12} While caesarean delivery may improve neonatal survival in selected high-risk cases, the rising trend of operative deliveries raises concerns regarding overuse and associated maternal morbidity.¹³

Tertiary care institutions, particularly those catering to rural and tribal populations, manage a substantial proportion of high-risk pregnancies. Evaluating maternal determinants and birth weight patterns in such settings provides valuable insights into region-specific risk factors and helps assess the effectiveness of antenatal and intrapartum care services.¹⁴ Therefore, the present study was undertaken to assess the relationship between maternal socio-demographic, obstetric, and nutritional factors and birth weight outcomes among deliveries conducted at a tertiary care hospital in Northern Maharashtra.

METHODOLOGY

This retrospective observational study was conducted at a tertiary care teaching hospital located in Northern Maharashtra. The study included records of all women who delivered at the institution between 1 January 2021 and 31 July 2021. The hospital caters predominantly to rural, tribal, and socioeconomically disadvantaged populations and serves as a referral center for high-risk obstetric cases.

Data were collected from the labour room and medical records department using indoor case files and delivery registers. A total of 524 deliveries occurred during the study period. After applying inclusion and exclusion criteria, 523 mother–neonate pairs were enrolled for final analysis. Women with incomplete medical records, intrauterine fetal death, or documented major congenital anomalies were excluded from the study.

Maternal variables extracted included age, gravidity, parity, gestational age at delivery, hemoglobin levels, antenatal care status, and mode of delivery. Socio-demographic details such as residence and referral status were noted wherever available. Neonatal variables included birth weight, gestational age, sex of the newborn, and birth outcome (live birth or stillbirth). Birth weight was recorded within one hour of delivery using a calibrated electronic weighing scale and documented in kilograms.

Gestational age was calculated based on last menstrual period (LMP) and/or first trimester ultrasonography, as recorded in case files. Neonates weighing less than 2.5 kg were classified as low birth weight in accordance with WHO criteria. Mode of delivery was categorized as full-term normal delivery (FTND) or lower segment caesarean section (LSCS).

As this was a retrospective record-based study, telephonic informed consent was obtained wherever feasible, and patient confidentiality was strictly maintained by anonymizing the data. The study protocol was conducted in accordance with the ethical standards of the institutional ethics committee. Data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Continuous variables were summarized using means and proportions, while categorical variables were expressed as frequencies and percentages. Associations between maternal factors, gestational age, mode of delivery, and neonatal birth weight were evaluated descriptively.

RESULTS

During the study period, a total of 524 deliveries were recorded at the tertiary care institute. Of these, 523 (99.8%) resulted in live births, while one (0.2%) was a stillbirth. The overall mean birth weight of live-born neonates was 2.53 kg. The stillborn fetus had a birth weight of 0.76 kg (Table 2).

Regarding the mode of delivery, 253 women (48.3%) delivered by full-term normal vaginal delivery (FTND), whereas 271 women (51.7%) underwent lower segment caesarean section (LSCS), indicating a higher proportion of operative deliveries in this tertiary referral center (Table 1).

Analysis based on gravidity showed that 232 women (44.3%) were primigravidae, 192 (36.7%) were second gravida, and 99 (19.2%) were third gravida or higher. The mean maternal age was highest among primigravidae (24.10 years). The average neonatal birth weight was comparable across gravidity groups, with a marginally higher mean birth weight observed among second gravida women (2.55 kg) compared to primigravidae (2.54 kg) (Table 3).

A strong association was observed between gestational age at delivery and neonatal birth weight. Neonates delivered before 28 weeks of gestation had a markedly low mean birth weight of 0.571 kg. A progressive increase in birth weight was noted with advancing gestational age, with the highest mean birth weight (2.879 kg) recorded in neonates delivered between 40 and 42 weeks of gestation (Table 4).

When gestational age was stratified by mode of delivery, caesarean section was more frequently performed among preterm and low birth weight neonates. Among LSCS deliveries, the highest average birth weight (2.853 kg) was observed in the post-term gestational age group (>40 weeks). In contrast, the highest average birth weight among FTND deliveries (3.55 kg) was noted in the 37–40 weeks gestational age group (Table 5).

With respect to maternal age, the majority of deliveries occurred among women aged 21–30 years (77.9%). The highest mean birth weight (2.75 kg) was observed in neonates born to mothers aged 31–40 years. Caesarean delivery was most commonly performed in the 21–30 years age group, while vaginal deliveries were relatively evenly distributed across age categories (Table 6).

Table 1: Distribution of Deliveries According to Mode of Delivery

Mode of Delivery	Number	Percentage (%)
FTND	253	48.3
LSCS	271	51.7
Total	524	100

Table 2: Birth Outcome and Average Birth Weight

Type of Birth	Number	Percentage (%)	Average Birth Weight (kg)
Live Births	523	99.8	2.53
Still Births	1	0.2	0.76

Table 3: Gravidity, Maternal Age, and Average Birth Weight

Gravidity	Number	Percentage (%)	Average Maternal Age (years)	Average Birth Weight (kg)
Primi	232	44.3	24.10	2.54
G2	192	36.7	23.92	2.55
≥G3	99	19.2	23.39	2.5

Table 4: Gestational Age and Average Birth Weight

Gestational Age (weeks)	Number of Deliveries	Average Birth Weight (kg)
<28	3	0.571
28–37	112	2.140
37–40	321	2.792
40–42	78	2.879

Table 5: Gestational Age, Mode of Delivery, and Average Birth Weight

Gestational Age (weeks)	LSCS (n)	Avg BW LSCS (kg)	FTND (n)	Avg BW FTND (kg)
<28	2	0.484	1	0.745
28–37	58	2.034	54	2.243
37–40	203	2.037	118	3.55
40–42	38	2.853	40	2.905

Table 6: Maternal Age, Mode of Delivery, and Birth Weight

Maternal Age (years)	Avg Birth Weight (kg)	LSCS n (%)	FTND n (%)
16–20	2.519	44 (15.9)	43 (16.9)
21–30	2.533	215 (77.9)	191 (75.5)
31–40	2.75	12 (4.3)	18 (7.1)
>40	2.61	0 (0)	1 (0.4)

DISCUSSION

The present retrospective observational study evaluated maternal and obstetric determinants influencing birth weight in a tertiary care hospital catering predominantly to rural and tribal populations of Northern Maharashtra. The overall mean birth weight of 2.53 kg observed in this study

is comparable to findings reported from similar Indian settings. Pal et al. from West Bengal reported a mean birth weight of 2.55 kg in a community-based study, highlighting persistent regional similarities in fetal growth patterns in resource-limited settings.¹⁵

The prevalence of caesarean section (51.7%) in the present study was notably higher than the WHO recommended rate. This finding is consistent with observations by Temerinac et al., who reported a higher caesarean section rate among pregnancies complicated by low birth weight and fetal compromise.¹⁰ Similarly, data from NFHS-4 have shown an increasing trend of operative deliveries in institutional births, particularly in tertiary referral centers.¹³ The elevated LSCS rate in our study can be attributed to the referral of high-risk pregnancies, including cases of severe anemia, hypertensive disorders, intrauterine growth restriction, and preterm labor.

Gestational age emerged as a strong determinant of neonatal birth weight in the present study. Neonates delivered before 28 weeks had extremely low birth weights, while a progressive increase in birth weight was observed with advancing gestation. This finding aligns with observations by Gutbrod et al., who demonstrated that gestational maturity significantly influences birth weight and subsequent neonatal outcomes.¹¹ Wubetu et al. also reported similar trends in an Ethiopian cohort, emphasizing gestational age as an independent predictor of birth weight.¹⁶

Analysis based on gravidity revealed minimal variation in average birth weight across gravidity groups, with slightly higher mean birth weight among second gravida women. Comparable findings were reported by Kader and Perera, who observed that gravidity alone does not significantly influence birth weight when adequate antenatal care is provided.³ However, other studies have reported higher rates of low birth weight among primigravidae, possibly due to biological immaturity and poor nutritional reserves.¹⁷

In the present study, caesarean delivery was more frequently performed among preterm and low birth weight neonates. A similar association was reported by Shi et al., who observed higher operative delivery rates in cases of fetal growth restriction and preterm birth.¹⁸ Temerinac et al. also demonstrated that neonates weighing less than 2.5 kg had almost double the likelihood of being delivered by caesarean section compared to normal birth weight neonates.¹⁰ These findings support the role of caesarean section in improving neonatal survival in selected high-risk situations.

Maternal age analysis showed that most deliveries occurred among women aged 21–30 years, with the highest mean birth weight observed in the 31–40 years age group. Similar findings were reported by Niswade et al., who noted improved birth weights among women in optimal reproductive age groups with better antenatal supervision.¹² However, advanced maternal age has also been associated with increased obstetric complications, underscoring the need for individualized risk assessment.¹⁹

The low stillbirth rate observed in this study reflects effective antenatal surveillance and timely obstetric intervention. This finding is comparable to reports from tertiary centers with established neonatal intensive care facilities.²⁰ Overall, the results highlight the importance of strengthening antenatal care, early identification of high-risk pregnancies, and timely referral to tertiary care centers to improve birth weight outcomes.

LIMITATIONS

The study has certain limitations. Being a retrospective record-based study, it was dependent on the accuracy and completeness of hospital records, which limited assessment of some maternal nutritional and socioeconomic variables. The study was conducted at a single tertiary care referral center, which may limit generalizability of the findings to the wider community. Additionally, inferential statistical analysis could not be performed, restricting causal interpretation of associations between maternal factors and birth weight.

CONCLUSION AND FUTURE DIRECTIONS

The present study highlights the significant influence of gestational age, maternal factors, and mode of delivery on neonatal birth weight in a tertiary care setting catering to rural and tribal populations. Despite a higher proportion of high-risk referrals and caesarean deliveries, favorable neonatal

outcomes and a low stillbirth rate were observed, reflecting effective antenatal surveillance and intrapartum care. Strengthening early antenatal registration, maternal nutrition, and timely referral of high-risk pregnancies can further reduce the burden of low birth weight.

Future studies with prospective design, multicentric participation, and detailed nutritional and biochemical assessment are recommended to better elucidate causal relationships and to guide targeted maternal and neonatal health interventions.

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