

Original Research Article

Determinants of low birth weight in a tertiary care setting of an aspirational district

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ABSTRACT

Background: Low birth weight (LBW) remains a critical challenge for neonatal survival and long-term health, particularly within India's aspirational districts. This study aims to identify the clinical, socioeconomic, and nutritional determinants of LBW in the high-altitude terrain of Himachal Pradesh.

Methods: A retrospective, hospital-based cross-sectional audit was conducted at a tertiary care centre. The study analysed data from 151 LBW infants (<2500 g) born between 1 April and 30 June 2025, using records from the HMIS portal, medical record section, and antenatal clinic registers.

Results: The facility reported a 15.5% LBW rate. Key determinants included poor antenatal care (ANC) utilization, with 50% of mothers failing to achieve early registration (within 12 weeks) and 79% attending fewer than the recommended four ANC visits. Nutritional factors; 32% of mothers were underweight at conception, and 44% achieved a gestational weight gain of less than 10 kg. Obstetric findings revealed that 80% of cases had birth intervals of less than three years, contributing to maternal nutrient depletion. Additionally, while 50% of pregnancies were categorized as high-risk, 95% of cases were non-referred, indicating that the tertiary facility is overburdened with routine deliveries.

Conclusions: The high incidence of LBW is driven by late clinical registration, maternal undernutrition, and systemic healthcare burdens. Improving outcomes requires precision interventions, including strengthened grassroots outreach for 100% early registration and the establishment of dedicated high-risk pregnancy clinics.

Keywords: Low birth weight, Aspirational district, Antenatal care, Maternal nutrition, Birth spacing, Public health, India

INTRODUCTION

Birth weight is a critical indicator of neonatal health, serving as a primary predictor of a newborn's immediate survival and long-term physical and cognitive development. It reflects both intrauterine conditions and the quality of maternal care.

Consequently, identifying the determinants of LBW-defined by the World Health Organization as a birth weight of less than 2,500 grams-is essential for mitigating its public health impact.¹

LBW is a multifactorial phenomenon resulting from preterm birth, intrauterine growth restriction, or both. It often manifests from underlying maternal health issues, including poor nutrition and inadequate ANC. Furthermore, LBW is linked to an increased risk of chronic conditions in adulthood, such as hypertension and type 2 diabetes-a concept known as the "Barker hypothesis."²

In India, LBW remains a significant barrier to achieving sustainable development goal targets. While national averages have improved, regional disparities persist in

"aspirational districts."³ In aspirational district of Himachal Pradesh, high-altitude terrain and socio-cultural factors frequently lead to maternal health complications and delayed clinical intervention.⁴ The study institution handles approximately 90% of the district's delivery load, making it a critical site for analysis. This study utilizes a retrospective audit of data to analyze the socioeconomic and clinical factors contributing to the 15.5% LBW rate in this region. By examining these variables, this research aims to highlight the interplay between maternal demographic profiles and neonatal outcomes in a resource-constrained rural setting.⁵

METHODS

A hospital-based, retrospective cross-sectional study (data audit) was conducted at a tertiary care centre in Chamba, Himachal Pradesh. Data were collected from three sources: the HMIS Portal, the medical record section, and antenatal clinic registers. The study included all records of LBW infants born between 1 April 2025 and 30 June 2025. Records with more than 20% missing data were excluded.

This retrospective institutional audit was commissioned by the District Health Administration, as a departmental quality-improvement activity at our tertiary care centre using fully de-identified institutional records; all data-protection safeguards-after taking administrative permission, removal of personal identifiers, alphanumeric coding, and password-protected storage-were applied in line with the ICMR National Ethical Guidelines on privacy and secondary use of routinely collected data, the declaration of Helsinki provisions on retrospective records, and accepted standards for clinical record-review studies.⁶⁻⁸

RESULTS

Based on hospital-based records of 151 low birth weight babies (<2500 gm) in tertiary care centre w.e.f. 1st April 2025 to 30th June 2025, the following factors have been identified as primary drivers for the high LBW incidence:

Poor ANC utilization

Late registration

As Figure 1, represents approximately half (50%) of mothers did not have "early booking" of pregnancy (within the first 12 weeks), and about one fifth (18%) had very late bookings entering the system only in the third trimester. This prevents early intervention for growth restriction.

Inadequate visits

Majority (79%) of mothers had fewer than the minimum 4 ANC visits requirement, leading to missed opportunities for identification of high-risk mothers and

prevents the timely detection of intrauterine growth restriction (IUGR) (Figure 2).

Socioeconomic and nutritional factors

Economic stress

As Figure 3 shows us that approximately half of the cases belong to the lowest socio-economic status (SES), with 62% of families reporting significant financial stress. There is also extra calorie as well as balance diet required during pregnancy and having financial stress, directly impacts the access to a balance and diverse diets.

Maternal nutrition

The 32% of mothers were underweight at the time of their gestation. Approximately half of mothers (44%) showed a total gestational weight gain of less than 10kg, failing to meet physiological requirements for healthy birth weight.

Family structure

The 56% live in joint families where "resource segregation" (distribution of food/rest) may unfavourably affect the pregnant mother.

Clinical and obstetric factors

Birth spacing

As Figure 4 highlights that vast majority (80%) of cases had a pregnancy interval of less than 3 years, which does not allow mother's body to replenish essential nutrients.

High-risk status

Over 50% of the cases were categorized as "high risk," yet the hospital manages a high volume of non-referred cases (95%), suggesting that institute is handling the bulk of district's complex cases without early-stage filtering.

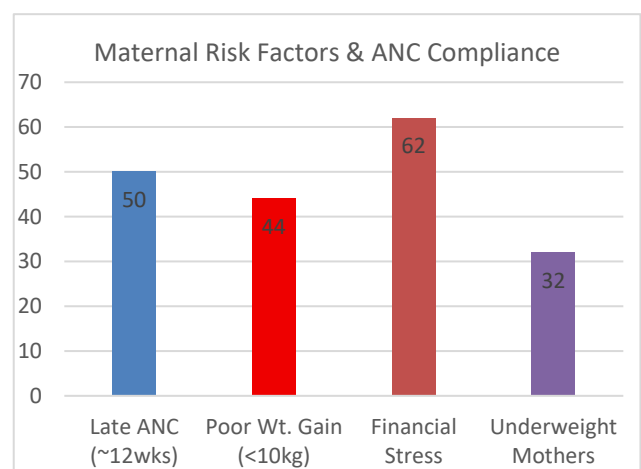


Figure 1: Maternal risk factors and ANC compliance of low-birth-weight babies.

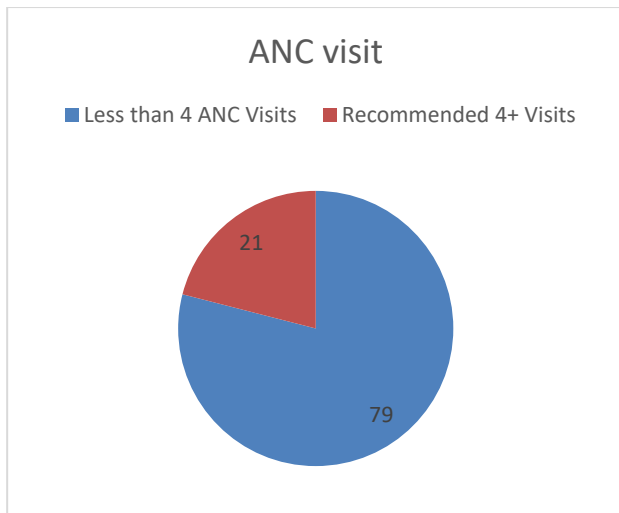


Figure 2: ANC visits of mothers of LBW babies.

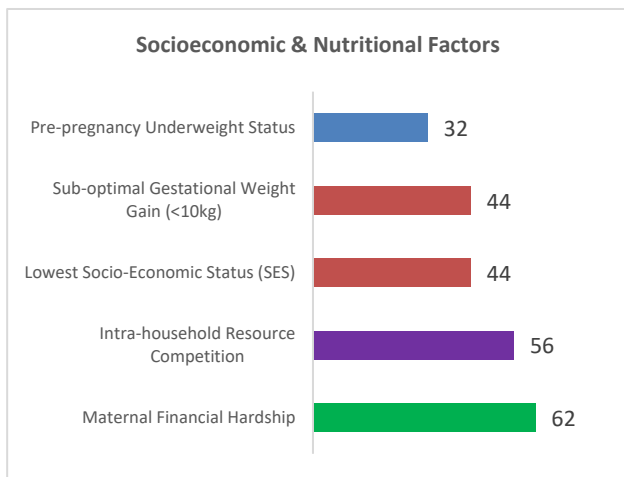


Figure 3: Socioeconomic and nutritional factors of mothers of LBW.

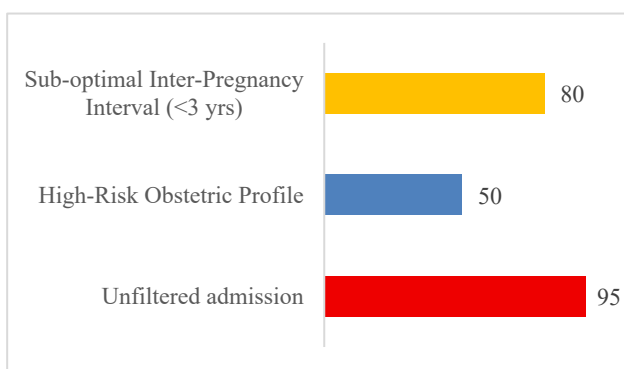


Figure 4: Clinical and obstetric factors of mothers of LBW babies.

DISCUSSION

The findings of this retrospective institutional audit provide critical insight into the multifactorial determinants of LBW in a high-altitude aspirational

district of Himachal Pradesh. The 15.5% prevalence of LBW observed in this cohort sits at the intersection of maternal health-seeking behaviour, household nutritional dynamics, and systemic healthcare delivery challenges specific to the Himalayan terrain.

ANC: the first line of defense

Our finding that 79% of mothers attended fewer than the recommended four ANC visits, and that approximately 50% had no early booking, aligns with the broader Indian literature documenting that inadequate ANC is a strong independent predictor of LBW.¹⁰ National evidence from NFHS-5 demonstrates that mothers with fewer than four ANC visits have significantly higher odds of delivering LBW infants compared to those who completed the full schedule.¹⁰ This is particularly concerning in our setting, where late registration inevitably compresses the window for early identification of high-risk pregnancies. A comparative study from a tertiary hospital in Nepal found that maternal age and prior history of preterm delivery were significant risk factors detectable only when ANC began in the first trimester.¹¹ The 18% of mothers in our study who registered only in the third trimester represent a missed opportunity for exactly this kind of early risk stratification.^{4,11}

Nutritional depletion and the maternal buffer hypothesis

The nutritional profile of this cohort is striking. With 32% of mothers underweight at conception and 44% achieving a gestational weight gain below 10 kg, the data suggest that a substantial number of pregnancies begin on a depleted maternal nutritional baseline. Retrospective analyses have identified maternal anaemia, inadequate gestational weight gain, and underweight pre-pregnancy BMI as independent determinants of birth weight.¹² This is further compounded by the 56% prevalence of joint family residence in our cohort, where "resource segregation"-the uneven intra-household distribution of food and rest-may limit the pregnant mother's nutritional access even when household-level food security exists.⁴ The short birth interval (less than three years) observed in 80% of our cases provides additional support for the Maternal Depletion Hypothesis, which posits that closely spaced pregnancies do not allow sufficient time for maternal nutrient stores to be replenished, thereby predisposing the subsequent foetus to growth restriction.⁹

Institutional burden and the high-risk paradox

Perhaps the most policy-relevant finding is the paradox that over 50% of these LBW cases were classified as "high risk," yet 95% were non-referred, routine admissions to the institution. This pattern suggests that the tertiary care centre is absorbing the role of a primary care facility, handling complex pregnancies without effective prior filtering at the grassroots level.¹³ Evidence from North Indian tertiary hospitals shows that high-risk

pregnancies are better managed when identified early in dedicated clinics with specialized personnel, rather than arriving late through non booked routes.¹³ Our own data echo this: studies comparing booked versus unregistered pregnancies consistently demonstrate that non booked cases have significantly worse foetal and perinatal outcomes.¹⁴ This highlights a structural disconnect between the primary health centre network and the tertiary institution in this aspirational district.⁴

In comparison to with regional and national benchmarks, the 15.5% LBW rate observed in this study is consistent with the Himachal Pradesh state average of 15.75% reported in NFHS-5.¹⁵ However, it is lower than the 17.5% to 24% LBW rates documented in a retrospective review from a tertiary care center in Shimla district, another hilly terrain in the same state.¹⁶ This suggests that despite the geographical and socioeconomic challenges of an aspirational district, clinical management at delivery is reasonably effective at this institution. Nationally, trends across 36 states and union territories indicate that LBW prevalence has been declining slowly but remains stubbornly high in geographically isolated and economically weaker districts.³ This regional comparison positions our study within a national conversation about equity in maternal-child health outcomes and underscores the need for district-level "precision data" rather than relying solely on aggregated state averages.^{3,15}

Public health significance

The findings of this study carry direct implications for two flagship Government of India programmes: the aspirational districts programme and the POSHAN Abhiyaan. The latter targets a 2% annual reduction in LBW prevalence nationally and emphasizes maternal nutrition in the first 1000 days.^{17,18} By identifying that nearly one-third of mothers were underweight at conception and almost half had inadequate gestational weight gain, this audit provides actionable, location-specific evidence to support targeted nutritional supplementation at the village level, rather than uniform distribution through the existing public distribution system.¹⁸ Furthermore, the demonstrated link between joint family residence and resource segregation suggests that behavioural change communication strategies must move beyond individual mothers and engage the entire household-particularly mothers-in-law-to influence intra-family food allocation.^{4,17}

Strengths and limitations

A key strength of this study is its high institutional coverage-the tertiary care centre handles approximately 90% of the district's total delivery load, providing a representative snapshot of maternal health outcomes in this aspirational district. The study also employs data triangulation across the HMIS portal, medical records, and antenatal clinic registers, which enhances reliability compared to single-source audits.

As a retrospective observational study, this audit is constrained by the quality and completeness of existing institutional records, which may introduce information bias. The absence of a healthy-weight control group prevents the calculation of odds ratios for the identified risk factors. Additionally, as a single-centre study in a Himalayan terrain, the findings may not be fully generalizable to aspirational districts in other topographical settings. Environmental confounders such as indoor air pollution and maternal physical workload were not captured in routine datasets.

CONCLUSION

The 15.5% LBW rate in this aspirational district is a multifactorial challenge driven by late registration, nutritional depletion, and socioeconomic stress. The institution's dual role as both a primary and tertiary facility necessitates stronger early-stage filtering at the grassroots level. This study provides a roadmap for transitioning to precision strategies to improve the health of children in this region.

Recommendations

A multi-pronged intervention is required:

Prioritize early registration

Increase outreach to achieve 100% pregnancy registration within the first trimester to facilitate early screening.

Nutritional monitoring

The 32% underweight group requires intensive monitoring of gestational weight gain and dietary counselling.

Enhance family planning

Improve postpartum family planning counselling to address the 80% of cases with short birth intervals.

Dedicated high-risk clinics

Establish a specialized high-risk pregnancy clinic to provide intensive monitoring for the 50% of high-risk mothers identified.¹⁹

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Conflict of interest: None declared

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