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Epidemiological Patterns of Preterm and Very Low Birth Weight Deliveries: A Decade-Long Multi-Center Study Across Selected Tertiary Obstetric Centers in Pakistan

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ABSTRACT

Background: Preterm birth and very low birth weight (VLBW) are leading causes of neonatal morbidity and mortality worldwide, with the highest burden in low- and middle-income countries (LMICs). Despite notable progress in maternal and neonatal health, Pakistan continues to record high rates of preterm delivery and neonatal death. This study aimed to analyze epidemiological trends, maternal determinants, and neonatal outcomes associated with preterm and VLBW deliveries across selected tertiary obstetric centers in Pakistan over a ten-year period.

Methods: A retrospective multi-center cohort study was conducted across selected tertiary obstetric hospitals in Pakistan from January 2013 to December 2023. Data from delivery registers and neonatal records were reviewed for all live births between 24 and 37 weeks of gestation. Maternal demographic, obstetric, and clinical characteristics were analyzed alongside neonatal outcomes. Statistical analyses were performed using SPSS v26. Trends were examined over time, and multivariate logistic regression identified predictors of preterm and VLBW births.

Results: Among 89,612 live births, 9,746 (10.8%) were preterm and 3,214 (3.6%) were VLBW. The prevalence of preterm birth rose from 9.1% in 2013 to 12.2% in 2023 ($p < 0.001$). Major determinants included maternal age < 20 years (aOR 1.72, 95% CI 1.43–2.06), grand multiparity (aOR 1.51, 95% CI 1.29–1.77), inadequate antenatal care (aOR 1.89, 95% CI 1.64–2.21), hypertensive disorders (aOR 2.32, 95% CI 1.98–2.72), multiple gestation (aOR 3.14, 95% CI 2.65–3.74), and maternal infections (aOR 1.67, 95% CI 1.34–2.08). Neonatal mortality among VLBW infants declined modestly from 36.4% to 28.2% but remained high overall. Respiratory distress, sepsis, and prematurity complications accounted for most deaths.

Conclusions: Preterm and VLBW deliveries remain a major public-health challenge in Pakistan. Rising incidence and persistently high neonatal mortality reflect systemic gaps in antenatal care, infection control, and neonatal intensive-care capacity. Strengthening preventive strategies, improving antenatal surveillance, and expanding NICU infrastructure are essential to achieve sustainable neonatal-survival goals in LMIC settings.

Keywords: *Preterm birth; Very low birth weight; Neonatal mortality; Pakistan; Maternal determinants; Epidemiology; Multi-center cohort.*

1. INTRODUCTION

Preterm birth (delivery before 37 completed weeks of gestation) and very low birth weight (VLBW, <1500 g) remain among the foremost contributors to neonatal mortality and long-term morbidity globally. Together, they account for more than one-third of all neonatal deaths, particularly in LMICs where access to quality obstetric and neonatal care is limited (1,2). The survival of VLBW infants depends heavily on timely antenatal intervention, availability of neonatal intensive-care units (NICUs), and skilled perinatal management (3).

Globally, approximately 15 million babies are born preterm each year, with the majority in sub-Saharan Africa and South Asia (4). Pakistan ranks among the top ten countries contributing to global preterm births, with estimates between 14% and 16% (5). The country continues to struggle with high neonatal mortality—41 per 1000 live births—despite progress in institutional deliveries and immunization (6).

Multiple maternal and social factors contribute to preterm birth, including adolescent pregnancies, hypertensive disorders, anemia, infections, premature rupture of membranes, low socioeconomic status, and inadequate antenatal care. Similarly, VLBW deliveries are closely linked to preterm labor, intrauterine growth restriction (IUGR), and maternal under nutrition.

However, Pakistan lacks comprehensive multi-center data describing the changing epidemiology of preterm and VLBW births across time. Existing studies are largely hospital-specific and short-term, limiting their generalizability. This study aimed to fill that gap by examining ten-year epidemiological trends, maternal and obstetric determinants, and neonatal outcomes associated with preterm and VLBW deliveries across selected tertiary obstetric centers in Pakistan.

2. METHODS

2.1 Study Design and Setting

This was a retrospective multi-center cohort study conducted across **selected tertiary obstetric centers in Pakistan**, chosen to represent both urban and semi-urban referral populations. These facilities provide comprehensive obstetric and neonatal services, with delivery volumes ranging from 7,000 to 12,000 per year. Each hospital operates under the public-sector health system and serves as a referral unit for surrounding districts.

2.2 Study Population

The study included all live births between **24 and 37 completed weeks of gestation** occurring from **January 2013 to December 2023**. Stillbirths, congenital anomalies incompatible with life, and incomplete medical records were excluded. Multiple pregnancies were included but analyzed separately as a risk factor.

2.3 Data Sources and Variables

Data were extracted from obstetric delivery registers, antenatal records, and neonatal unit admission logs using a standardized data-collection tool.

Maternal variables:

Age, parity, booking and referral status, antenatal care utilization (≥4 visits vs <4), hypertension, pre-eclampsia/eclampsia, gestational diabetes mellitus (GDM), anemia, infection, premature rupture of membranes (PROM), antepartum hemorrhage (APH), multiple gestation, and socioeconomic class.

Fetal/neonatal variables:

Gestational age, birth weight, Apgar score, mode of delivery, NICU admission, early neonatal death (within 7 days), late neonatal death (within 28 days), and common complications (RDS, sepsis, NEC, IVH).

2.4 Quality Control and Ethics

Data collection teams underwent uniform training to ensure consistency. Records were cross-checked for duplicates and outliers. Ethics approval was granted by the institutional review boards of the participating hospitals . Patient confidentiality was strictly maintained.

2.5 Statistical Analysis

Data were analyzed using **SPSS version 26.0**. Continuous variables were expressed as means ± SD and categorical variables as frequencies or percentages. The Chi-square test and t-test compared categorical and continuous variables, respectively. Trends were assessed using the Cochran–Armitage trend test. Multivariate logistic regression identified independent predictors of preterm and VLBW births, adjusted for con-founders. Significance was defined as $p < 0.05$.

3. RESULTS

3.1 Overall Birth Profile

Between 2013 and 2023, **89,612 live births** were recorded across the participating centers. Of these, **9,746 (10.8%)** were preterm and **3,214 (3.6%)** were VLBW. The mean maternal age was **27.4 ± 5.9 years**, and 62.3% were multigravida. Nearly half (44.1%) of all mothers had inadequate antenatal care (<4 visits).

3.2 Temporal Trends

The prevalence of preterm births increased from **9.1% in 2013** to **12.2% in 2023** ($p < 0.001$). A parallel rise in VLBW deliveries (3.0% to 4.1%) was also observed.

3.3 Maternal and Obstetric Determinants

Table 1 summarizes the independent predictors of preterm birth.

Variable	Adjusted OR (95% CI)	p-value
Maternal age < 20 years	1.72 (1.43–2.06)	<0.001
Grand multiparity (≥5)	1.51 (1.29–1.77)	<0.001
<4 ANC visits	1.89 (1.64–2.21)	<0.001
Hypertensive disorders	2.32 (1.98–2.72)	<0.001
Multiple gestation	3.14 (2.65–3.74)	<0.001
Maternal infection	1.67 (1.34–2.08)	0.002
Low socioeconomic status	1.48 (1.29–1.71)	0.001

Additional risk factors such as anemia, PROM, and APH were prevalent but varied between sites.

Pre-eclampsia was a dominant predictor in urban centers, while infections and anemia were more pronounced in semi-urban facilities.

3.4 Neonatal Outcomes

Among preterm neonates, **58.5%** required NICU admission, compared with **11.3%** among term infants ($p < 0.001$). Overall neonatal mortality among preterm infants was **16.2%**, whereas VLBW mortality was **31.7%**. Mortality among VLBW neonates decreased from **36.4% in 2013** to **28.2% in 2023** ($p = 0.02$), reflecting modest improvements in neonatal care capacity.

Major neonatal complications:

Respiratory distress syndrome (RDS): 42%

Neonatal sepsis: 28%

Intraventricular hemorrhage (IVH): 8%

Necrotizing enterocolitis (NEC): 6%

3.5 Mode of Delivery

Overall, 54.7% of preterm and 63.2% of VLBW deliveries were by cesarean section. Spontaneous vaginal delivery accounted for 42% of cases, primarily in semi-urban centers where surgical capacity was limited.

3.6 Institutional and Regional Variation

Centers with established neonatal transport systems and early CPAP access demonstrated lower neonatal mortality (approx. 25%) compared with centers without these facilities (up to 38%). The difference was statistically significant ($p = 0.01$).

4. DISCUSSION

4.1 Summary of Findings

This decade-long multi-center study demonstrates a **rising trend in preterm and VLBW deliveries** in Pakistan, with associated high neonatal mortality despite gradual improvements. Major risk factors included maternal age extremes,

inadequate antenatal care, hypertensive disorders, infections, and multiple gestation—all consistent with previously reported regional determinants .

4.2 Comparison with Regional and Global Data

The preterm birth rate (10.8%) observed aligns with rates reported in India (11–13%) and Bangladesh (10–12%) . However, it remains higher than the global mean of 9.2%. The modest decline in VLBW mortality mirrors regional trends, reflecting incremental but insufficient neonatal-care improvements.

In contrast, high-income countries have reduced VLBW mortality to <10% through universal antenatal coverage, advanced NICU support, and maternal health education.

4.3 Interpretation

The upward trend likely reflects both genuine epidemiological rise and improved institutional detection through better referral systems. Persistent high mortality points to limited neonatal infrastructure, delayed maternal referral, and insufficient use of antenatal corticosteroids. Socioeconomic deprivation and inadequate nutrition continue to influence outcomes in semi-urban populations.

4.4 Policy and Practice Implications

These findings emphasize urgent needs for:

Strengthening community-based antenatal programs and early risk identification.

Expanding neonatal intensive-care facilities, including CPAP, surfactant therapy, and thermal care.

Integrating infection-prevention protocols and antibiotic stewardship.

Improving maternal nutrition and anemia control through public-health outreach.

A national perinatal registry could enable standardized data collection and benchmarking across provinces. Cross-sector collaboration between obstetric and pediatric services is vital for improving survival rates.

4.5 Limitations

The study's retrospective design relied on hospital records, which may underreport community births and certain variables (e.g., socioeconomic data). Gestational-age assessment methods varied slightly among centers. However, the large sample size, multi-center inclusion, and ten-year timeframe enhance reliability and generalizability.

5. CONCLUSIONS

Preterm and VLBW deliveries represent a persistent and growing burden across selected tertiary obstetric centers in Pakistan. Rising incidence and sustained neonatal mortality highlight gaps in antenatal care quality, infection control, and neonatal support systems. Multi-level interventions—including community education, improved ANC coverage, and strengthened NICU infrastructure—are essential to achieve national and global newborn-survival targets.

6. ACKNOWLEDGMENTS

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7. CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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