

# Pakistan's Persisting Trend of High Neonatal Mortality and Its Determinants: An In-depth Analysis of Pakistan Maternal Mortality and Morbidity Survey 2019

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## Research Article

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# Abstract

## Objective

To examine national and provincial trends in neonatal mortality in Pakistan and identify key socioeconomic and biological determinants using nationally representative data.

## Study design:

This is a secondary analysis of cross-sectional survey data.

## Place and duration:

This study utilized data from the National Institute of Population Studies Pakistan Maternal Mortality Survey (PMMS) 2019, conducted nationwide across all provinces and regions of Pakistan. The original survey was implemented in 2019.

## Methodology:

Data were derived from the Pakistan Maternal Mortality Survey 2019. Neonatal mortality was defined as death within 28 days of birth. Descriptive statistics estimated neonatal mortality rates (NMR) nationally and provincially. Bivariate associations were assessed using chi-square tests. Multivariable binary logistic regression was performed to estimate adjusted odds ratios (AORs) with 95% confidence intervals (CI) for socioeconomic and biological risk factors, controlling for maternal age, parity, wealth quintile, residence, antenatal care, place of delivery, and postnatal care.

## Results

Marked provincial disparities were observed, with Sindh demonstrating the highest NMR (58.9 per 1,000 live births), while Gilgit-Baltistan reported the lowest (27.5 per 1,000). High parity significantly increased neonatal mortality risk: mothers with 3–5 prior births (AOR 1.54; 95% CI 1.17–2.02) and  $\geq 6$  births (AOR 2.16; 95% CI 1.48–3.15). Younger maternal age ( $< 25$  years) was also associated with higher odds (AOR 1.83; 95% CI 1.26–2.65). The lowest wealth quintile showed significantly elevated risk (AOR 1.80; 95% CI 1.18–2.76). Prematurity and maternal complications were strongly associated with increased neonatal mortality.

## Conclusions

Neonatal mortality in Pakistan remains disproportionately high, with significant provincial inequities and strong associations with high parity, young maternal age, and poverty. Strengthening family planning services, expanding comprehensive antenatal care, and addressing socioeconomic disparities are critical to accelerating progress toward national and global child survival targets.

## Introduction

Neonatal mortality in Pakistan remains alarmingly high, exceeding 30 deaths per 1,000 live births, despite global and regional declines. As a critical marker of maternal health, healthcare infrastructure, and socioeconomic development, the neonatal mortality rate (NMR) reflects the quality of care across the prenatal, intrapartum, and postnatal continuum. While neighboring countries such as India, Bangladesh, and Sri Lanka have already achieved the Sustainable Development Goal (SDG) 3.2 target of  $\leq 12$  deaths per 1,000 live births by 2030, Pakistan's progress has stagnated.<sup>1,2</sup> This persistent burden is driven by limited access to quality maternal and newborn services, inadequate antenatal care coverage, shortages of skilled birth attendants, high rates of neonatal infections, entrenched socioeconomic inequities, and weak health system governance. Addressing these systemic challenges is essential to accelerate reductions in neonatal mortality and ensure Pakistan's alignment with global child survival goals. Figure 1 highlights significant reductions in NMR between 2000 and 2025 across all countries of South Asia, with Bangladesh and Nepal showing the steepest declines, while Pakistan's progress remains extremely slow.

The high burden of neonatal mortality in Pakistan arises from a complex interplay of medical, social, and systemic determinants. Birth asphyxia and trauma remain prevalent due to shortages of skilled birth attendants and inadequate emergency obstetric care. Prematurity and low birth weight, often linked to poor maternal nutrition and insufficient antenatal coverage, further contribute to early deaths.

Neonatal infections, including sepsis, pneumonia, and tetanus, are widespread, exacerbated by poor hygiene practices and delays in treatment. These medical risks are compounded by limited access to healthcare in rural and underserved areas, low maternal education and awareness, entrenched gender disparities, and poverty, all of which restrict timely and effective care-seeking.

The timing of neonatal deaths underscores the urgency of these challenges: more than three-quarters occur within the first week of life, with up to 40% in the first 24 hours. This concentration highlights critical gaps in intrapartum care, immediate newborn resuscitation, and early postnatal support.<sup>3</sup>

Compared to regional peers, Pakistan's neonatal mortality rate remains disproportionately high. Current estimates place Pakistan's NMR at  $\sim 30.6$  per 1,000 live births, with  $\sim 75\%$  of deaths occurring in the first week. In contrast, India ( $\sim 15.8$ ;  $\sim 60\%$ ), Bangladesh ( $\sim 12.0$ ;  $\sim 55\%$ ), Nepal ( $\sim 11.4$ ;  $\sim 50\%$ ), and Sri Lanka ( $\sim 4.8$ ;  $<40\%$ ) demonstrate significantly lower rates.<sup>2</sup> Pakistan also ranks third globally in newborn deaths within the first 24 hours. Neighboring countries have achieved reductions through community-

based interventions, female education, and institutional deliveries, while Sri Lanka's success reflects universal healthcare coverage, skilled birth attendance, and robust referral systems.

This study undertakes a secondary analysis of the Pakistan Maternal Mortality Survey (PMMS) 2019 to examine neonatal mortality rates and associated risk factors at both national and provincial levels. The PMMS 2019 was a nationally representative survey implemented by the National Institute of Population Studies (NIPS), Pakistan, with technical assistance from the Demographic and Health Survey (DHS) program of the United States.<sup>4</sup> Data on neonatal deaths and maternal and child health indicators were collected through household interviews, birth histories, and detailed modules on healthcare access, service utilization, and socioeconomic characteristics. By leveraging this robust dataset, the present analysis aims to identify key determinants of neonatal mortality and highlight provincial disparities, thereby informing targeted interventions to accelerate progress toward national and global child survival goals.

## Methodology

SNK, SB: the acquisition, analysis, or interpretation of data for the work

FM, SB: Drafting the work or revising it critically for important intellectual content

FM: Supervised the case documentation and provided final approval of the manuscript

All authors have read and approved the final draft for publication.

### Conflict of Interest:

None **Funding Source:** None

## Study Design and Duration

This study was an analytical secondary data analysis of a nationally representative cross-sectional survey, the Pakistan Maternal Mortality Survey 2019. The original survey was conducted in 2019 across all provinces and administrative regions of Pakistan. The present analysis focused specifically on neonatal mortality and its determinants.

## Study Setting

The survey was implemented nationwide by the National Institute of Population Studies in collaboration with the Demographic and Health Survey (DHS) Program. A stratified, two-stage cluster sampling design ensured representation across provinces, urban and rural strata, and major geographic regions.

## Ethical Considerations

The PMMS 2019 received ethical approval from the relevant institutional review authorities, and the dataset is publicly available and fully anonymized. As this study involved secondary analysis of de-identified data, it was exempt from additional ethical review.

## **Sample Size and Sampling Technique**

PMMS 2019 employed a stratified two-stage cluster sampling methodology. In the first stage, enumeration areas were selected using probability proportional to size sampling. In the second stage, households were systematically selected within each cluster. The overall survey sample was calculated by the parent study to ensure adequate power for estimating maternal and neonatal mortality indicators at national and provincial levels. Sampling weights were applied in the original dataset to adjust for clustering, stratification, and unequal probability of selection.

## **Study Population**

The study population comprised women of reproductive age (15–49 years) who had experienced live births during the reference period preceding the survey. Neonatal outcomes for these live births were analyzed.

## **Data Collection**

Data were collected through structured household interviews using standardized questionnaires. Detailed birth histories were obtained, including information on neonatal survival status, maternal health, antenatal care utilization, delivery characteristics, postnatal care, and pregnancy-related complications. Socioeconomic variables such as household wealth index and place of residence were also recorded.

## **Study Variables**

### **Outcome Variable:**

- Neonatal mortality (death within 28 days of birth).

### **Independent Variables:**

- Maternal age at birth
- Parity
- Comprehensive antenatal care
- Place of Delivery
- Postnatal care

- Self-reported pregnancy and delivery complications

## Covariates:

- Household wealth quintile
- Urban/rural residence

## Statistical Analysis

Data analysis was conducted using SPSS version 17. Descriptive statistics were used to estimate neonatal mortality rates (per 1,000 live births) at national and provincial levels. Bivariate associations between neonatal mortality and explanatory variables were assessed using chi-square tests. Multivariable binary logistic regression analysis was performed to determine independent predictors of neonatal mortality. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated after controlling for maternal age, parity, wealth quintile, residence, place of delivery, and postnatal care. Statistical significance was set at  $p < 0.05$ .

## Results

The analysis of neonatal mortality rates (NMR) across provinces and regions of Pakistan reveals marked geographic disparities (Fig. 2). Sindh exhibited the highest NMR at 58.9 per 1000 live births, with a 95% confidence interval (CI) ranging from 47.7 to 70.2, indicating a significantly greater burden compared to other regions. In contrast, Gilgit-Baltistan (GB) reported the lowest NMR at 27.5 per 1000 live births (95% CI: 16.2–38.9), suggesting comparatively better neonatal survival outcomes.

Punjab, Khyber Pakhtunkhwa (KP), and Balochistan demonstrated intermediate levels of neonatal mortality, with rates of 39.8, 37.9, and 38.9 per 1000 live births, respectively. Their confidence intervals overlap considerably, indicating no statistically significant differences among these provinces. Azad Jammu and Kashmir (AJK) recorded an NMR of 35.3 per 1000 live births (95% CI: 22.9–47.7), which is lower than Punjab, KP, and Balochistan, but still higher than GB.

Overall, the findings highlight Sindh as a high-risk region for neonatal mortality, while GB demonstrates relatively favorable outcomes. The overlapping confidence intervals across Punjab, KP, Balochistan, and AJK suggest that while their point estimates differ, the true rates may not vary substantially. These results underscore the need for region-specific interventions, particularly targeted efforts in Sindh, to reduce neonatal mortality and improve equity in child survival across Pakistan.

Figure 3 presents the NMR per 1000 live births associated with maternal and perinatal complications, with their approximate 95% confidence intervals. Pregnancies complicated by vaginal bleeding, seizures, hypertension, or excessive bleeding before delivery were all associated with significantly higher neonatal mortality compared to unaffected pregnancies. As expected, the most pronounced effect was observed for premature birth, with an NMR of 86.1 per 1000 live births among premature births versus

39.0 among term births ( $p < 0.001$ ). These findings highlight the critical role of maternal complications and prematurity in determining neonatal survival outcomes.

Table I presents the adjusted odds ratios (AORs) from a logistic regression model assessing socioeconomic and biological determinants of neonatal mortality in Pakistan. Higher parity was significantly associated with increased neonatal mortality: mothers with 3–5 prior live births had 61% higher odds (AOR = 1.61; 95% CI: 1.02–2.52), and those with  $\geq 6$  live births had more than double the odds (AOR = 2.10; 95% CI: 1.27–3.47). Lack of comprehensive antenatal care was also a significant risk factor, associated with a 35% reduction in odds of neonatal survival (AOR = 0.65; 95% CI: 0.46–0.91). Note that the AORs provide the risk associated with the factor after controlling for all the other variables shown in the table, including maternal age, urban or rural residence, wealth quintile, place of delivery, and postnatal care. These risk factors, however, showed no statistically significant association with neonatal death in this analysis.

| Table I. Adjusted Odds Ratios (AOR) and their 95% Confidence Intervals (CI) for Selected Socio-Demographic and Biological Risk Factors. |      |             |             |         |
|-----------------------------------------------------------------------------------------------------------------------------------------|------|-------------|-------------|---------|
| Risk Factors                                                                                                                            | AOR  | Lower Limit | Upper Limit | p-Value |
| <b>Mother's Residence (Ref. Urban)</b>                                                                                                  |      |             |             |         |
| Rural                                                                                                                                   | 0.84 | 1.07        | 0.66        | .164    |
| <b>Wealth Quintile (Ref. Highest Wealth Quintile):</b>                                                                                  |      |             |             |         |
| Lowest Quintile                                                                                                                         | 1.80 | 1.18        | 2.76        | .006    |
| Second Quintile                                                                                                                         | 1.06 | 0.69        | 1.63        | .781    |
| Middle Quintile                                                                                                                         | 1.18 | 0.79        | 1.77        | .421    |
| Fourth Quintile                                                                                                                         | 1.10 | 0.73        | 1.67        | .655    |
| <b>Mother's age at birth (Ref. 35 + years)</b>                                                                                          |      |             |             |         |
| < 25 years                                                                                                                              | 1.83 | 1.26        | 2.65        | 0.00    |
| 25–34 years                                                                                                                             | 1.09 | 0.81        | 1.47        | 0.58    |
| <b>Parity (Ref. 1–2 prior live births)</b>                                                                                              |      |             |             |         |
| 3–5 prior live births                                                                                                                   | 1.54 | 2.02        | 1.17        | 0.00    |
| 6 or more prior live births                                                                                                             | 2.16 | 3.15        | 1.48        | 0.00    |
| <b>Comprehensive antenatal care (Ref. Yes)</b>                                                                                          |      |             |             |         |
| No                                                                                                                                      | 0.75 | 0.54        | 1.06        | 0.11    |
| <b>Place of delivery (Ref. Home)</b>                                                                                                    |      |             |             |         |
| Hospital                                                                                                                                | 1.29 | 1.01        | 1.63        | 0.04    |
| <b>Postnatal care (Ref. No)</b>                                                                                                         |      |             |             |         |
| Yes                                                                                                                                     | 1.46 | 0.98        | 2.16        | 0.06    |

## Discussion

This study highlights both the progress and persistent challenges in reducing neonatal mortality in Pakistan. Comparative trends across South Asia show that while Pakistan has achieved a gradual decline in neonatal mortality since 2000, its pace of reduction lags behind neighboring countries such as Bangladesh and Nepal, which have recorded sharper declines. Sri Lanka and Iran, with stronger health systems and sustained investments in maternal and child health, demonstrate that substantial

reductions are achievable when service delivery is consistent and equitable. Pakistan's slower progress underscores systemic weaknesses in health service coverage, quality, and utilization.<sup>5</sup>

A critical concern is the timing of neonatal deaths in Pakistan. Over 75% of neonatal deaths occur within the first seven days of life, with nearly 40% happening in the first 24 hours. This early mortality pattern highlights systemic gaps in intrapartum care, immediate newborn resuscitation, and postnatal support.<sup>6</sup> The lack of skilled birth attendants, inadequate emergency obstetric services, and poor hygiene practices contribute significantly to preventable causes such as birth asphyxia, sepsis, pneumonia, and complications from prematurity.<sup>7</sup>

Socioeconomic factors further exacerbate the crisis. Low maternal literacy, gender disparities, and poverty restrict access to timely and quality healthcare. Pakistan's Lady Health Worker (LHW) program, while ambitious, has faced challenges in coverage, training, and integration into neonatal care strategies. In contrast, Bangladesh's success with community health workers and Sri Lanka's universal healthcare model demonstrates the effectiveness of well-coordinated, equity-focused interventions.<sup>8,9</sup>

Moreover, Pakistan's health system suffers from underinvestment in primary care, fragmented service delivery, and weak governance. These structural issues hinder the implementation of evidence-based policies and limit the scalability of successful pilot programs. Without urgent reforms and sustained political commitment, Pakistan risks falling further behind in achieving global child survival goals.

Pakistan's neonatal mortality crisis is a reflection of broader systemic and social inequities. Addressing it requires a multi-sectoral approach that strengthens health systems, improves maternal education, ensures equitable access to care, and fosters accountability in service delivery.

The regression analysis further illuminates critical determinants of neonatal mortality within Pakistan. High parity emerged as a significant risk factor, with mothers having three or more prior live births facing markedly higher odds of neonatal death. This finding reflects the cumulative biological risks of repeated pregnancies and the socioeconomic constraints that limit access to quality maternal care among high-parity women. Lack of comprehensive antenatal care was also significantly associated with increased neonatal mortality, emphasizing the importance of preventive and timely interventions during pregnancy. Conversely, factors such as maternal age, wealth quintile, residence, and place of delivery did not show significant associations, suggesting that structural barriers in service delivery may outweigh individual socioeconomic differences.

Across low- and middle-income countries, neonatal mortality is consistently higher among households in extreme poverty, reflecting constrained access to quality care and nutrition.<sup>10</sup> Younger maternal age at birth, particularly under 25 years, is associated with increased neonatal death, driven by biological immaturity and social disadvantage.<sup>11</sup> High parity elevates risk through maternal depletion and shorter interpregnancy intervals.<sup>12</sup> Lack of comprehensive antenatal care increases mortality by missing opportunities to detect and manage maternal and fetal risks.<sup>13</sup> Obstetric complications— including

antepartum hemorrhage, hypertensive disorders, and preterm birth—are major contributors to neonatal mortality via placental insufficiency, iatrogenic or spontaneous prematurity, and intrapartum compromise.<sup>14,15</sup>

Taken together, these findings have two key implications: First, Pakistan's neonatal mortality reduction requires accelerated efforts to expand and improve maternal health services, particularly antenatal care, and to address the risks associated with high parity. Second, the comparative regional trends highlight the potential for Pakistan to learn from successful models in neighboring countries, where integrated health systems, community-based interventions, and strong policy commitment have driven substantial improvements. Strengthening family planning services to reduce high parity, ensuring universal access to antenatal care, and improving continuity of care from pregnancy through the neonatal period are essential strategies to close the gap with regional peers.

## Conclusion

Neonatal mortality in Pakistan remains unacceptably high, with pronounced provincial disparities and significant associations with high parity, young maternal age, and socioeconomic disadvantage. The findings indicate that structural gaps in family planning services, comprehensive antenatal care, and equitable health service delivery continue to impede progress. Targeted, province-specific strategies that strengthen primary maternal–newborn care, expand access to quality antenatal services, and address high fertility patterns are essential to accelerate reductions in neonatal mortality and achieve Sustainable Development Goal 3.2.

## Policy Implication

The findings underscore the urgent need for Pakistan to strengthen its maternal and neonatal health policies with a sharper focus on family planning, antenatal care, and parity reduction. High parity remains a critical driver of neonatal mortality, highlighting the importance of revitalizing family planning programs to ensure accessible, culturally sensitive, and community-driven services. Expanding comprehensive antenatal care coverage—particularly in underserved rural and low-income urban areas—should be prioritized to improve early detection and management of risks during pregnancy.

Lessons from regional peers such as Bangladesh and Nepal demonstrate that integrated community-based interventions, coupled with strong political commitment, can accelerate progress. Policymakers must invest in scalable, evidence-based strategies that align with Pakistan's health system constraints while ensuring accountability, equity, and sustainability across local, district, and provincial levels.

## Abbreviations

AJK: Azad Jammu and Kashmir, AOR: Adjusted Odds Ratio, CI: Confidence Interval, DHS: Demographic and Health Survey, GB: Gilgit-Baltistan, KP: Khyber Pakhtunkhwa, LHW: Lady Health Worker, NIPS:

National Institute of Population Studies, NMR: Neonatal Mortality Rate, PMMS: Pakistan Maternal Mortality Survey, SDG: Sustainable Development Goal, SPSS: Statistical Package for the Social Sciences, WHO: World Health Organization

## Declarations

## Author Contribution

FM: Substantial contributions to the conception or design of the workSNK, QU, SB: the acquisition, analysis, or interpretation of data for the work FM, SNK, SB: Drafting the work or revising it critically for important intellectual content FM: Supervised the case documentation and provided final approval of the manuscriptAll authors have read and approved the final draft for publication.

## Data Availability

Publicly available data from Pakistan Maternal Mortality Survey  
2019<https://dhsprogram.com/methodology/survey/survey-display-552.cfm>

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## Figures

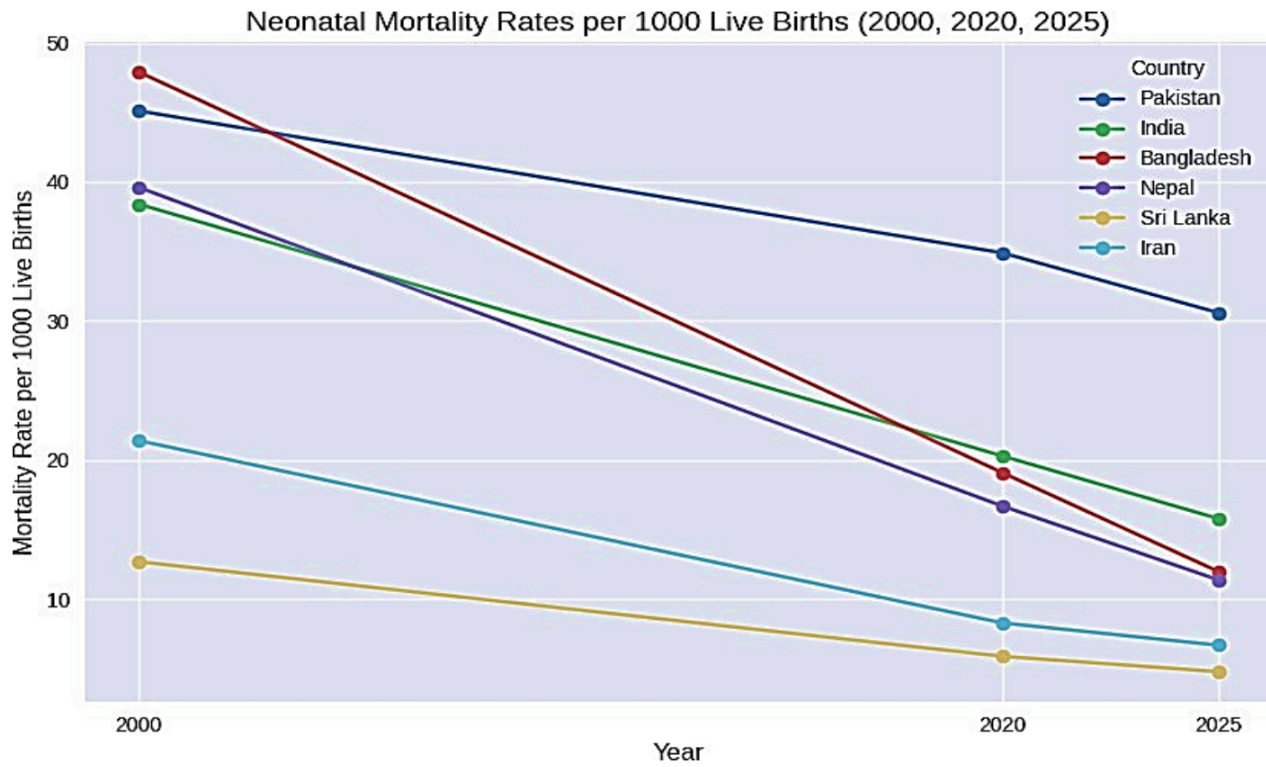


**Figure 1**

Trends in Neonatal Mortality Rates (per 1000 Live Births) in Pakistan, India, Bangladesh, Nepal, Sri Lanka, and Iran from 2000 to 2025

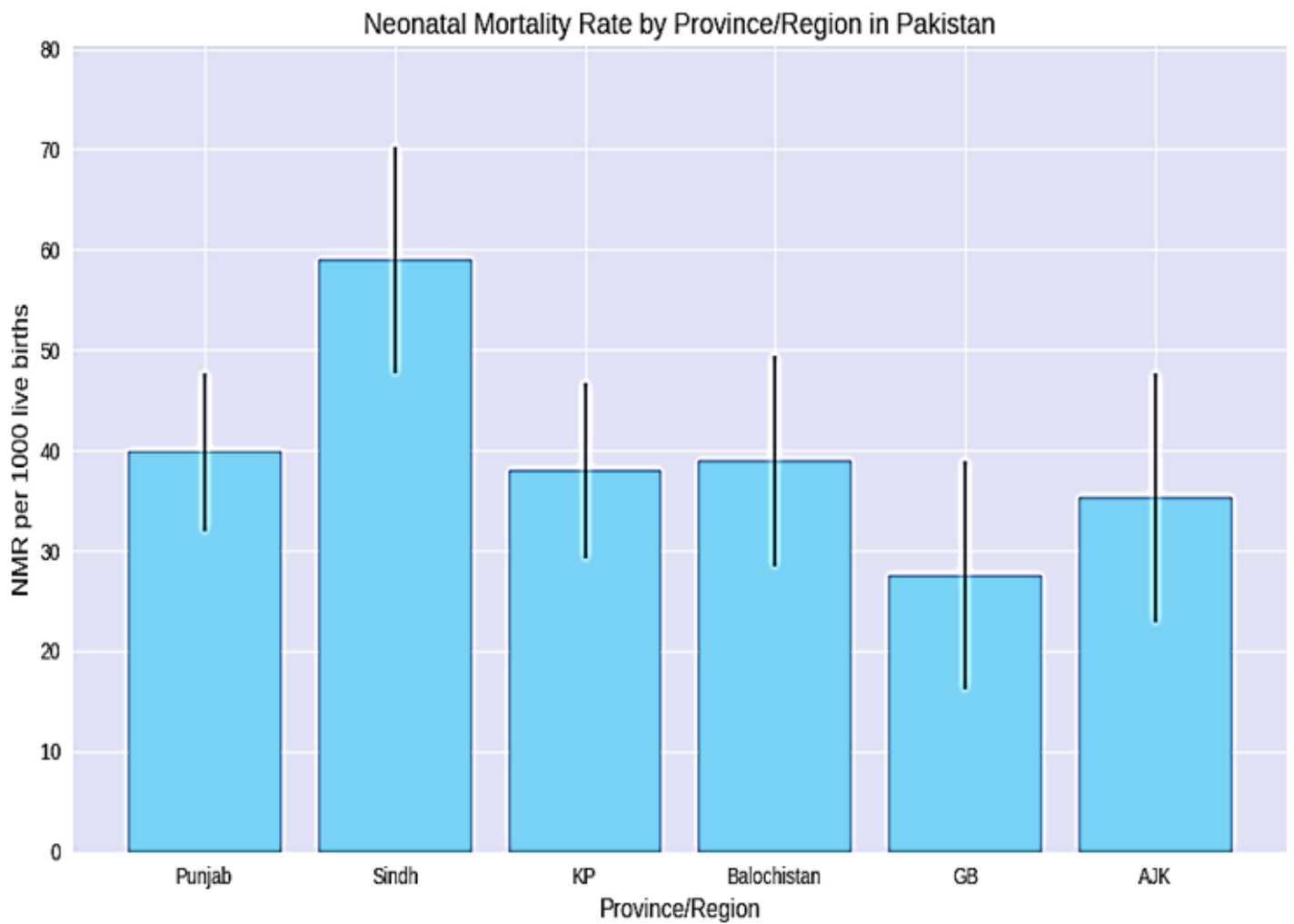


**Figure 2**

Neonatal Mortality Rates (NMR) per 1000 Live Births Across Provinces/Regions of Pakistan

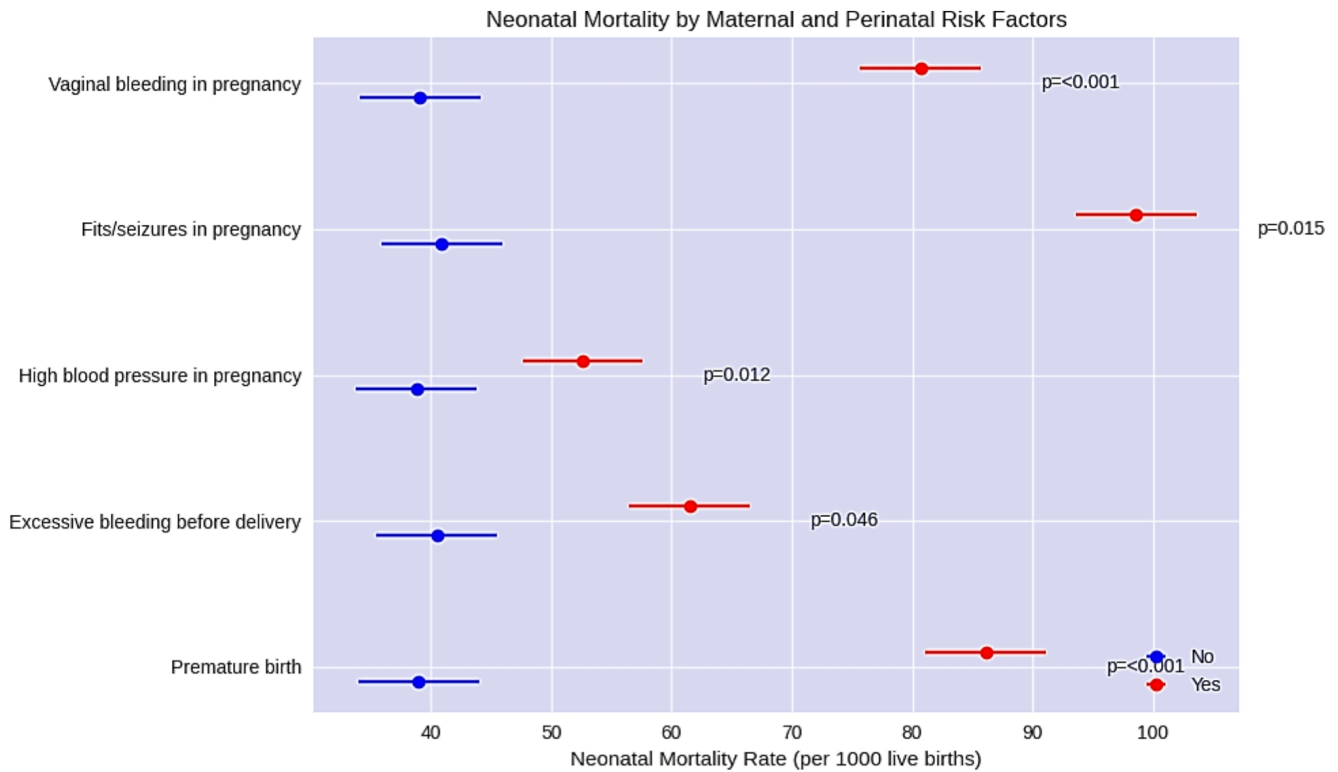


**Figure 3**

Neonatal Mortality Rates (NMR) per 1000 Live Births are Associated with Maternal and Perinatal Risk Factors, with Approximate 95% Confidence Intervals.