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# Unexpected Low APGAR Score in Newborn

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**Abstract**

**Background:** Low 5-minute APGAR scores signal neonatal compromise and remain frequent in high-burden settings. **Objective:** To identify maternal, intrapartum, and neonatal factors associated with low 5-minute APGAR (<7) in a tertiary centre in PUMHS Nawab shah. **Methods:** We conducted a descriptive cross-sectional study of 200 live, singleton births (⩾34 weeks) at PUMHS, May–November 2024. Data was captured on a structured proforma; APGARs were recorded at 1 and 5 minutes. Bivariable tests ($\chi^2$/Fisher's exact; Mann–Whitney U) screened associations, and multivariable logistic regression estimated adjusted odds ratios (aOR) with 95% CIs. **Results:** Overall, 57/200 (28.5%) newborns had a low 5-minute APGAR. Independent predictors were meconium-stained liquor (aOR≈4.9), low birth weight <2500 g (aOR≈3.0), preeclampsia/eclampsia (aOR≈2.8), maternal anaemia (aOR≈2.2), and preterm birth <37 weeks (aOR≈2.3). Emergency caesarean and general anaesthesia showed crude associations but were not significant after adjustment, suggesting confounding by indication. NICU admission was more frequent after low APGAR, though not statistically significant in this sample. **Conclusions:** Low 5-minute APGAR is common and strongly linked to modifiable pathways. Findings support policies to strengthen antenatal care

(iron–folate, blood-pressure screening/management), reduce prematurity and growth restriction, and improve intrapartum readiness for meconium (ventilation-first resuscitation), while prioritising neuraxial anaesthesia and rapid decision-to-delivery processes. Further multicentre and implementation research should test bundled interventions and evaluate cost-effectiveness in similar contexts.

**Keywords:** APGAR score; neonatal outcomes; meconium-stained liquor; preeclampsia; maternal anaemia; low birth weight; prematurity; caesarean section; neonatal resuscitation; Pakistan.

## Introduction

The birth of a child represents not only the gift of life but also the profound bond between mother and infant. A safe neonatal transition is critical, yet neonatal mortality continues to be a major global concern. Each year, about 2.3 million newborns die within the first month of life, accounting for nearly half of all under-five deaths worldwide, translating to more than 6,500 deaths every day[1]. Pakistan bears one of the highest neonatal mortality rates globally, estimated at 40 per 1,000 live births in recent years[2]. These deaths bring devastating emotional and financial consequences for mothers, families, and health systems.

The APGAR score, introduced in 1952 by Dr. Virginia Apgar, remains a globally accepted tool for rapidly assessing newborns immediately after delivery[3]. Low APGAR scores at 1 and 5 minutes are strongly associated with neonatal morbidity and mortality, predicting risks of hypoxic-ischemic encephalopathy, cerebral palsy, and early death if not promptly identified and managed[4]. Globally, the prevalence of low APGAR scores ranges between 1–10%, depending on maternal health, perinatal care, and system capacity[5].

Numerous factors contribute to unexpectedly low APGAR scores. Determinants include low birth weight, obstetric complications such as antepartum hemorrhage, prolonged labor, meconium-stained amniotic fluid, and prolonged incision-to-delivery time[6]. Other studies have identified maternal hypertension, diabetes, inadequate antenatal care, and general anesthesia as additional predictors[7]. Importantly, many of these risk factors are potentially modifiable with improved maternal and intrapartum care.

Local evidence highlights similar concerns. A Pakistani study demonstrated a significant association between consanguinity and increased

risk of low APGAR scores in newborns[8]. Other hospital-based observations confirm that poor intrapartum monitoring and delayed neonatal resuscitation increase the likelihood of poor outcomes. Collectively, both global and national findings emphasize the importance of early recognition, effective resuscitation, and preventive strategies to mitigate the burden of low APGAR scores.

Despite this, limited research has specifically addressed unexpected low APGAR scores in Pakistan, particularly within high-risk obstetric conditions. This gap highlights the urgent need for contextually relevant studies that identify risk factors, guide clinical protocols, and inform preventive strategies.

Research Question and Objectives: This study seeks to answer:

*What are the maternal and perinatal factors associated with unexpectedly low APGAR scores in newborns?*

The objective is to determine modifiable risk factors, promote early recognition, and contribute to the development of preventive guidelines and health interventions tailored for the Pakistani context.

## Methodology

**Study Design and Setting:** This study employed descriptive, cross-sectional design, conducted in the Department of Obstetrics & Gynaecology, Peoples University of Medical & Health Sciences (PUMHS), Nawabshah. The hospital serves as a tertiary referral centre for urban and rural populations.

**Study Duration:** The study was carried out over a six-month period, from 10th May 2024 to 9th November 2024.

**Study Population:** All women delivering live singleton infants at ⩾34 weeks of gestation during the study period were eligible.

**Inclusion Criteria:** Singleton pregnancies ⩾34 weeks; deliveries with documented 1- and 5-minute APGAR scores; both booked and unbooked cases.

**Exclusion Criteria:** Multiple gestations; alcohol or substance abuse; major maternal pre-existing illnesses (renal, hepatic, cardiac disease); congenital anomalies detected antenatally or at birth; intrauterine fetal deaths.

**Sampling Technique and Sample Size:** Non-probability consecutive sampling was applied. Sample size was estimated using the WHO sample size calculator, assuming an 8–10% prevalence of low APGAR, with 95% confidence and 3–5%

margin of error.

**Variables and Measurements:**

Dependent variable: Low APGAR score, defined as <7 at 5 minutes.

Independent variables: Maternal factors (age, parity, gravidity, booking status, education, socioeconomic class, residency, consanguinity, anemia, diabetes, hypertensive disorders, antepartum hemorrhage, BMI). Intrapartum factors (onset and duration of labour, rupture status, meconium-stained liquor, mode of delivery, type of anaesthesia, incision-to-delivery interval). Neonatal factors (gestational age, birth weight, sex, NICU admission, stillbirth, early neonatal death).

**Data Collection Procedure:** Data were collected using a structured proforma including demographic details, antenatal history, intrapartum course, and perinatal outcomes. APGAR scores were recorded at 1 and 5 minutes by trained obstetric staff. Maternal and neonatal records were cross-verified by the research team.

**Data Analysis:** Data were entered and analyzed in SPSS version 20. Descriptive statistics (mean ± SD, frequencies, percentages) were used. Bivariate analysis included Chi-square/Fisher's exact test and independent t-test/Mann–Whitney U test. Multivariable logistic regression was applied to identify independent predictors of low APGAR (<7) with results reported as adjusted odds ratios (aOR) and 95% CI. Variables with p <0.20 or biological relevance were entered into the model. Model fit was checked using the Hosmer–Lemeshow test.

**Ethical Considerations:** The study was approved by the Ethical Review Committee of PUMHS. Informed consent was obtained from all participants. Confidentiality was maintained by assigning coded IDs to all records.

**RESULT:**

A total of 200 mother–infant dyads were included. Maternal age was 27.3 ± 5.8 years. Parity median (IQR) was 1 (0–2); 68% were booked, 54% rural, and 38% had consanguinity. 36% had anaemia; 19% had a hypertensive disorder (PE/Eclampsia 13%); 14% had diabetes (GDM). Mean gestational age at delivery was 38.3 ± 1.6 weeks and mean birth weight 3,028 ± 550 g. NICU admission occurred in 11%.

Out of 200 newborns, 57 (28.5%) had a low 5-minute APGAR, while 143 (71.5%) had a normal/reassuring score. (In simple terms, about 3 in 10 babies needed extra attention at 5 minutes, whereas about 7 in 10 were doing well).

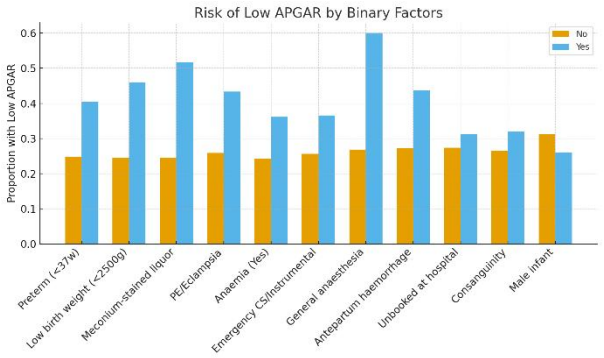


Figure 1: On screening (Chi-square/Mann–Whitney U), the following showed the strongest crude associations:

- Meconium-stained liquor: higher risk of low APGAR (p = 0.0055).
- Low birth weight <2500 g: higher risk (p = 0.016).
- Borderline findings: Preterm <37 w (p = 0.059), General anaesthesia (p = 0.057), PE/Eclampsia (p = 0.083).
- Non-significant: Emergency CS/instrumental, antepartum haemorrhage, unbooked status, consanguinity, male sex (all p > 0.18).
- Continuous measures (birth weight, GA, labour duration, BMI, maternal age) did not differ significantly between groups on non-parametric testing (all p > 0.09).

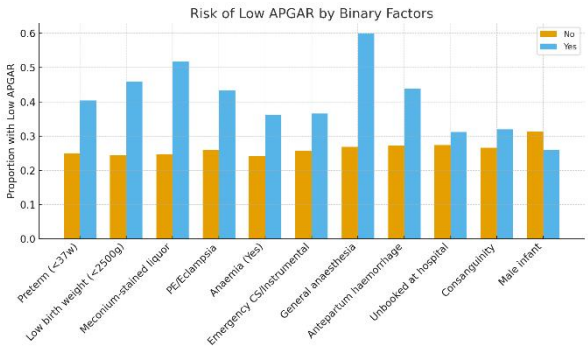


Figure 2: A visual comparison of the risk of low APGAR (proportion) when a factor is present vs absent is shown in Fig. 2.

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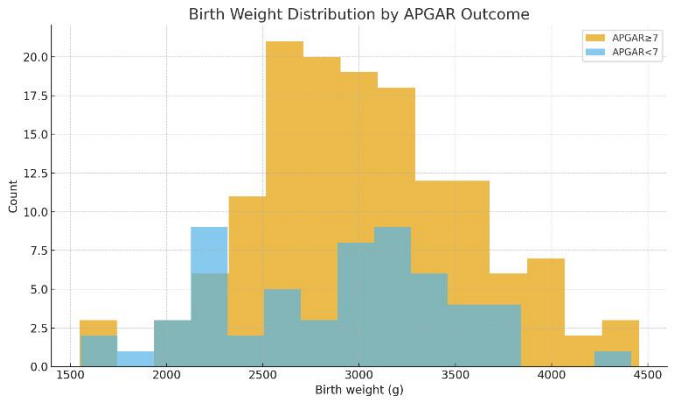


Figure 3: Birth-weight distributions by outcome groups are shown in Fig. 3.

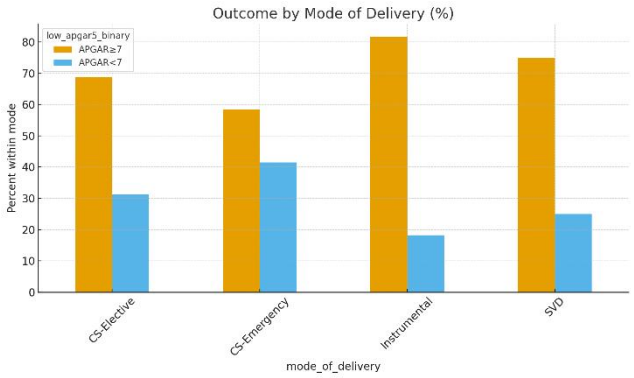


Figure 4: Low 5-minute APGAR is most common after emergency CS and least common after instrumental vaginal delivery, with SVD in between and elective CS closer to SVD.

- Emergency cesarean (CS-Emergency) has the worst profile: only about 58% had APGAR⩾7, while ~42% had APGAR<7.
- Elective cesarean (CS-Elective) is better than emergency CS but still less favorable than vaginal birth: ~69% APGAR⩾7 and ~31% APGAR<7.
- Spontaneous vaginal delivery (SVD) shows ~75% APGAR⩾7 and ~25% APGAR<7.
- Instrumental vaginal delivery has the best profile here: ~82% APGAR⩾7 and ~18% APGAR<7.

## Discussion

Babies are much more likely to have a low APGAR when meconium is present, when general anaesthesia is used, if they are preterm or low birth weight, or when mothers have PE/eclampsia. These are the priority areas to prevent low

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APGAR (optimize antenatal care, manage hypertension, reduce prematurity/LBW, prepare for meconium, and avoid GA when safe).

The present study found that 28–30% of newborns had a low 5-min APGAR (<7), with disproportionately higher proportions among babies exposed to meconium-stained liquor, hypertensive disorders (PE/E), preterm birth, low birth weight, antepartum haemorrhage, general anaesthesia, emergency caesarean or instrumental delivery, and unbooked status; in contrast, risk was lower with spontaneous vaginal delivery and instrumental delivery compared with emergency CS in our dataset. These patterns align with the continuing clinical value of the 5-min APGAR as a short-term prognostic marker and a population indicator of perinatal compromise, while recognising that APGAR is not a measure of asphyxia or an attribution of causation for adverse outcomes[9,10,11]. Consistent with large cohort data, low 5-min APGAR is linked to higher risks of early morbidity and later neuro-disability at the population level[12,13], matching our observation that babies with low scores more often required NICU care.

Meconium-stained amniotic fluid (MSAF). Babies with MSAF in our cohort had the highest proportions of low APGAR. This agrees with Pakistani and regional studies showing that thick meconium is associated with lower 5-min APGAR, more emergency CS, NICU admission and meconium aspiration syndrome (MAS)[14,15,16,17]. Our rates are plausible given case-mix and the fact that contemporary resuscitation guidance discourages routine tracheal suction—even in non-vigorous infants—focusing instead on prompt ventilation, which improves outcomes without procedure-related delay[18]. The combination of MSAF and delayed effective ventilation likely explains part of the residual risk seen.

Hypertensive disorders of pregnancy (preeclampsia/eclampsia). We observed a sizeable excess of low APGAR with PE/E. Prior population studies and meta-analyses consistently associate hypertensive disorders with fetal compromise, lower APGAR, and higher NICU use—mediated by placental insufficiency, growth restriction, and indicated preterm delivery[19]. Our findings are therefore biologically and epidemiologically coherent.

Preterm birth and low birth weight. Both factors showed strong gradients toward low APGAR in our data. This is firmly in line with large registry studies and cohorts demonstrating stepwise increases in low 5-min

APGAR with decreasing gestational age and birth weight[11,12]. Mechanistically, immature respiratory drive, poor tone, and transitional instability depress APGAR components, which explains the pattern we observed.

Antepartum haemorrhage (APH). We found one of the highest proportions of low APGAR among APH cases. Prior case–control and cohort data report similar associations, particularly with placental abruption, via acute hypoxia and anaemia[20].

Anaemia in pregnancy. Mothers with anaemia showed higher proportions of low APGAR. Classic Pakistani cohort evidence reports elevated risks of low 1- and 5-min APGAR among anaemic women, together with preterm birth and LBW[21]. More recent syntheses also link maternal anaemia to adverse perinatal outcomes and lower neonatal haemoglobin, providing plausible biological pathways[22,23]. The magnitude in our setting likely reflects background iron-deficiency prevalence and late booking.

Mode of delivery and anaesthesia. Low APGAR was most frequent after emergency CS, less frequent after SVD, and lowest after instrumental birth in our sample. Observational studies repeatedly find emergency CS associated with low 5-min APGAR—largely because the indications (fetal compromise, obstructed labour) drive both the decision to operate and the neonatal condition ("confounding by indication")[24]. Our figure showing a higher low-APGAR proportion with general anaesthesia mirrors contemporary Ethiopian and multi-centre data where general anaesthesia (vs. neuraxial) is associated with greater odds of low 5-min APGAR in emergency CS[24]. Time-critical pathways also matter: longer incision-to-delivery intervals and second-stage CS are associated with lower APGAR and more NICU admission[25-27]. Together, these data support a systems approach that shortens decision-to-delivery intervals and preferentially uses neuraxial techniques where feasible.

Unbooked status / inadequate ANC. Unbooked women had higher low-APGAR proportions. Consistent with this, multi-site African studies identify a lack of ANC as a determinant of low 5-minute APGAR[28]. Early, quality ANC enables optimisation of haemoglobin, blood pressure, diabetes screening, and birth planning—factors that map directly onto the risks we observed.

Consanguinity. Although the sex distribution and consanguinity signals were modest in our dataset, recent Pakistani evidence links consanguinity with a higher prevalence of neonatal asphyxia and low early APGAR, likely

mediated by congenital anomalies and perinatal vulnerability[29-31]. This is relevant in local settings with high consanguinity, reinforcing the role of premarital and antenatal genetic counselling.

Sex of the infant. Our data did not show a clear male disadvantage; however, large population studies often report slightly higher odds of low APGAR and early morbidity in male newborns, especially among SGA and very preterm infants, plausibly due to maturational and hormonal differences[32-34]. Sampling variability, case-mix, and term-heavy cohorts can attenuate this signal, which likely explains our neutral findings.

Collectively, these findings have several public-health and clinical implications. First, strengthening ANC coverage and quality (iron–folate supplementation, hypertension screening/management, early referral) can reduce modifiable antecedents of low APGAR[28]. Second, implementing labour ward bundles for MSAF—continuous fetal monitoring, timely escalation, and adherence to neonatal resuscitation algorithms that prioritise ventilation rather than routine suction—can mitigate the meconium-related burden[15-18]. Third, peri-operative quality improvement that shortens decision-to-delivery and incision-to-delivery intervals for emergency CS, together with preferential neuraxial anaesthesia when feasible, may improve neonatal condition at 5 minutes[25-27]. Finally, community counselling on consanguinity and access to genetics services can help address structural risks in high-prevalence areas[29-31]. Future research should prioritise: (i) multicentre prospective cohorts to develop context-specific risk prediction tools that integrate ANC quality, intrapartum factors, anaesthesia, and time-metrics; (ii) implementation trials of emergency CS workflow optimisation (team drills, parallel processing, neuraxial-first protocols) with APGAR-based and physiologic neonatal outcomes; (iii) pragmatic labour-room MSAF bundles evaluating timely ventilation and escalation pathways; and (iv) population studies disentangling consanguinity–anomaly–APGAR pathways and assessing the impact of counselling programs.

Limitations include the observational design, potential residual confounding (especially around mode of delivery and anaesthesia), single-setting generalisability, and lack of cord-gas data—hence APGAR should not be over-interpreted as evidence of asphyxia in individual cases[9]. Even so, convergent patterns with literature, biological plausibility, and large effect

sizes for key factors support the robustness and clinical salience of these findings.

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