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Original Research Article

# Antenatal Corticosteroid Exposure and Its Association with Respiratory Morbidity Among Preterm Neonates

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**Abstract:**

**Background:** Infants born too early are at a higher risk of developing respiratory distress syndrome (RDS) due to pulmonary immaturity and insufficient surfactant production. Antenatal corticosteroids help in the development of lungs in fetus and may reduce respiratory morbidity in case of preterm delivery.

**Aim:** To examine the relationship between exposure to antenatal corticosteroids and respiratory morbidity in preterm neonates including incidence of RDS, need for respiratory care, neonatal outcomes and adjusted association with RDS.

**Methodology:** A hospital-based retrospective observational design was adopted, and the work was carried out in the neonatal unit of Patna Medical College and Hospital (Bihar, India) over a period of one year. This is an sample of 200 premature neonates who were divided into corticosteroid exposed and non-exposed groups equally. Their maternal and neonatal charts were reviewed, and statistical processing was performed with SPSS software (IBM, version 25.0). Respiratory morbidity and some other confounding factors were studied with group comparison and binary logistic regression.

**Results:** In the study, RDS was found in 32% of exposed neonates compared to 52% of unexposed neonates (p= 0.004). RDS patients were less likely to be exposed to respiratory care, surfactant and mechanical ventilation. Also, median days for which respiratory care was provided was less in exposed group (2 vs 4 days; p= 0.012). On adjusted analysis, antenatal corticosteroid exposure remained inversely related to RDS (aOR 0.48; 95% CI 0.25-0.90; p = 0.023). Mortality, sepsis and length of stay did not differ between the groups.

**Conclusion:** Exposure to antenatal corticosteroids reduced respiratory morbidity among preterm neonates. Clinical data and suitable statistical analysis is required to confirm the findings in this study.

**Keywords:** Antenatal corticosteroids; preterm neonates; respiratory distress syndrome; respiratory support; neonatal outcomes; logistic regression.

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## Introduction

Preterm birth is still one of the most important public health issues since it is associated with infant morbidity, mortality, and the need for advanced medical services [1]. Preterm infants who are defined as infants delivered prior to 37 weeks of gestation usually suffer from respiratory disorders due to the physiological immaturity of lungs [2]. One of such respiratory problems is respiratory distress syndrome (RDS). It is associated with the deficiency of pulmonary surfactant and immature development of lungs [3]. Respiratory distress is characterized by the impairment of gas exchange, alveoli stability, and increased respiratory effort [4]. The risk and severity of respiratory disorders depend on the gestational age, birth weight, antenatal status, and neonatal intensive care [5].

Antenatal corticosteroids are widely used in obstetric practice in case of possible preterm delivery [6]. The use of these medications accelerates the lung maturity and stimulates the production of pulmonary surfactant [7]. Antenatal corticosteroids should be prescribed to decrease neonatal respiratory problems and complications caused by the immaturity of the lungs [8]. Among the most often prescribed antenatal corticosteroids there are betamethasone and dexamethasone which contribute to the maturation of lungs [9]. Nevertheless, the potential effects of antenatal corticosteroid use may differ depending on the gestational age at corticosteroid prescription, time period between treatment and delivery,

completeness of treatment, and preterm delivery clinical circumstances [10].

Despite the recent advances in antenatal management and neonatal intensive care, respiratory problems remain the considerable burden among preterm infants [11]. The necessity of supplementary additional oxygen, CPAP (airway pressure support given continuously), ventilator assistance, and surfactant replacement may complicate and prolong neonatal care [12]. Moreover, it may lead to the prolongation of hospitalization and more resources usage. Thus, analysis of the relationship between antenatal corticosteroids and respiratory outcomes can give us the insight into the contribution of these medications to the neonatal respiratory health. Besides the examination of RDS, the analysis of respiratory support needs, in-hospital mortality, neonatal sepsis, and hospitalization period is necessary [13].

The analysis of the connection between antenatal corticosteroids and neonatal respiratory outcomes should be conducted while taking into account certain maternal and neonatal factors. Gestational age and birth weight are the most important variables as they are strongly associated with pulmonary maturity and the risks of respiratory disorders [14]. Maternal hypertensive disorders, mode of delivery, and other clinical factors may also influence the process of preterm delivery and the risks of neonatal respiratory problems [15]. Therefore, comparative studies adjusted for these factors will give us a better picture of the relationship between antenatal corticosteroid exposure and neonatal respiratory morbidity.

This study aimed to evaluate how antenatal corticosteroid exposure relates to respiratory outcomes in preterm neonates admitted to Patna Medical College and Hospital in Patna, Bihar, India. Its specific objectives were the comparison of the incidence of respiratory distress syndrome between exposed and unexposed neonates; the assessment of the difference in respiratory support needs, including surfactant administration, mechanical ventilation, and duration of the support; comparison of short-term neonatal outcomes, including death during hospitalization, neonatal sepsis, and duration of hospital stay; assessment of the association between antenatal corticosteroid exposure and respiratory distress syndrome adjusted for relevant maternal and neonatal factors.

## Methodology

The objective of this research was to determine the relation between antenatal steroids and the respiratory status of the preterm neonates who were admitted in the neonatal care center of a tertiary care center. The methods were planned to test whether antenatal steroid use goes along with fewer cases of RDS, a lower requirement for breathing assistance, and improved early neonatal outcomes. Data collection took place at Patna Medical College & Hospital in Bihar, India.

**Study Design:** A retrospective observational study on cohorts from a hospital was carried out to investigate the link between antenatal corticosteroid exposure and respiratory health issues among premature infants. Depending on whether the mother had received antenatal corticosteroids, infants were allocated to one of two groups: those whose mothers were given the steroids before delivery, and those whose mothers were not given any. The analysis was done through review of clinical records from the mother and infant to evaluate respiratory outcomes between the two groups.

**Study Area:** The research was carried out in the neonatology department of Patna Medical College and Hospital, Patna, Bihar, India. This institution functioned as a referral center for high-risk pregnancies, preterm deliveries, and neonatal problems. The neonatal ward offered specialized treatment such as breathing help, constant clinical monitoring, and treatment of problems related to prematurity. The hospital setting enabled access to antenatal records of the mothers, delivery records, and records of admission of the infants necessary in assessing antenatal exposure to corticosteroids and their effect on breathing problems.

**Study Duration:** The study covered a period of one year from February 2025 to January 2026.

**Study Participants:** The study subjects included preterm neonates delivered prior to 37 weeks of gestation and admitted to the neonatal ward within the study period. The use of antenatal corticosteroids was evaluated by review of maternal records, while respiratory outcomes and clinical features were determined from neonatal records.

### Inclusion Criteria

The following criteria were used to select eligible participants:

1. Preterm neonates with a gestational age of 28 weeks to 36 weeks 6 days at birth.
2. Neonates admitted to the neonatology unit of the study hospital within the study period.
3. Availability of documented maternal antenatal corticosteroid exposure status.
4. Availability of gestational age, birth weight, delivery details, and relevant neonatal clinical records.
5. Availability of sufficient clinical information to determine the presence or absence of respiratory distress syndrome and other specified respiratory outcomes.

### Exclusion Criteria

Neonates meeting any of the following conditions were not included:

1. Neonates having major congenital anomalies affecting respiratory function or survival.
2. Neonates with chromosomal abnormalities or major congenital cardiopulmonary malformations that substantially influenced respiratory management.
3. Neonates transferred from another healthcare facility after receiving substantial respiratory treatment when the relevant birth and treatment records were unavailable.
4. Neonates with incomplete maternal records that prevented reliable classification of antenatal corticosteroid exposure.
5. Neonates with insufficient clinical documentation to establish the primary respiratory outcome.

**Sample Size:** The study included a total sample size of 200 preterm babies, where 100 preterm babies were from the exposed group, and 100 preterm babies were from the unexposed group. It is worth noting that the sample size would make it easier to conduct a comparative evaluation of respiratory outcomes among the two groups in the one-year study period.

In conducting a sample-size calculation, the following parameters would have been considered; the expected incidence of neonatal respiratory distress syndrome among the exposed and unexposed groups, the effect size, the statistical power required, and the level of significance. A two-sided significance level of 5% and a power of 80% would have been assumed.

**Study Procedure:** Medical records of the mothers and neonates were reviewed using a data extraction proforma to obtain relevant information about maternal age, maternal antenatal history, corticosteroid use, gestational age, method of delivery, birth weight, neonatal gender, Apgar score, and clinical findings. Corticosteroids use during pregnancy was categorized as none, partial course, or full course depending on the records, while the main comparison was done between exposed and non-exposed neonates. Main outcomes of this study were respiratory distress syndrome (RDS), and the secondary outcomes were need for respiratory support, mechanical ventilation, use of surfactant, period of respiratory support, and mortality in the hospital. Confounders like gestational age, birth weight, antenatal complications, multiple pregnancies, delivery method, and maternal risk factors were also documented. All obtained data were then verified for consistency, duplication, and completeness before analysis.

**Statistical Methods:** Data entry, coding and analysis were carried out in SPSS (IBM Corp., version 25.0). Quantitative variables were summarized as mean ± standard deviation or as median with interquartile range, and qualitative variables as counts and percentages. Comparison of the exposed and non-exposed groups relied on the independent-samples t-test or the Mann-Whitney U test for continuous measures, and on the chi-square test or Fisher's exact test for categorical measures, as appropriate. Binary logistic regression was applied to examine the link between antenatal corticosteroid exposure and RDS, controlling for confounders including gestational age, birth weight, delivery mode and selected maternal risk factors. All p-values were two-sided, and $p < 0.05$ was taken as statistically significant.

**Result**

A total of 200 preterm infants were used in the hypothesis test, consisting of 100 infants exposed to antenatal corticosteroids and 100 infants without any antenatal corticosteroid exposure. Clinical characteristics and respiratory outcomes were assessed in the two groups to assess the relationship between antenatal corticosteroid exposure and neonatal respiratory morbidity. The analysis involved baseline characteristics, occurrence of RDS, respiratory support needs, neonatal outcomes, and adjustment for primary outcome association.

Table 1 provides the baseline characteristics of the two groups of infants. Maternal age, gestational age, birth weight, sex ratio, delivery mode and multiple pregnancy were comparable across the groups, with no statistically significant differences ($p > 0.05$); the groups were therefore well matched on the baseline variables studied.

**Table 1: Baseline Characteristics of Mothers and Neonates**

| Variables | Corticosteroid-exposed (n = 100) | Unexposed (n = 100) | p-value |
|---|---|---|---|
| Age of mother (years), mean ± SD | 27.4 ± 4.8 | 26.9 ± 5.1 | 0.472 |
| Gestation at delivery (weeks), mean ± SD | 32.8 ± 2.1 | 32.4 ± 2.3 | 0.202 |
| Birth weight (g), mean ± SD | 1,785 ± 420 | 1,710 ± 445 | 0.224 |
| Male neonates, n (%) | 56 (56.0) | 53 (53.0) | 0.671 |
| Caesarean delivery, n (%) | 64 (64.0) | 60 (60.0) | 0.558 |
| Multiple pregnancy, n (%) | 14 (14.0) | 12 (12.0) | 0.668 |

As is illustrated in Table 2, the incidence of RDS was found to be 32.0% among babies who had been exposed to corticosteroids, while it was 52.0% among those who had not been exposed. The results were statistically significant (p = 0.004). There was a difference of 20 percentage points between the two groups, with the incidence being lower in the former case.

**Table 2: Frequency of RDS by Antenatal Corticosteroid Exposure Status**

| Respiratory distress syndrome | Corticosteroid-exposed (n = 100) | Unexposed (n = 100) | p-value |
|---|---|---|---|
| Present, n (%) | 32 (32.0) | 52 (52.0) | 0.004 |
| Absent, n (%) | 68 (68.0) | 48 (48.0) | — |
| Total, n (%) | 100 (100.0) | 100 (100.0) | — |

Table 3 shows variation in the use of respiratory support among the two groups. More neonates in the exposed group did not require any respiratory support as compared to those in the unexposed group (42.0% versus 61.0%; p = 0.007). Also, there were fewer incidences of surfactant therapy and mechanical ventilation in the exposed group. Respiratory support also lasted longer in unexposed neonates than in exposed neonates (median 4 days versus 2 days; p = 0.012).

**Table 3: Comparison of Respiratory Support Requirements**

| Respiratory support outcome | Corticosteroid-exposed (n = 100) | Unexposed (n = 100) | p-value |
|---|---|---|---|
| Any respiratory support, n (%) | 42 (42.0) | 61 (61.0) | 0.007 |
| Surfactant administration, n (%) | 24 (24.0) | 41 (41.0) | 0.009 |
| Mechanical ventilation, n (%) | 18 (18.0) | 31 (31.0) | 0.031 |
| Days on respiratory support, median (IQR) | 2 (1–5) | 4 (2–7) | 0.012 |

Table 4 illustrates the short-term neonatal outcomes in both groups. Death during hospital stay occurred in 5.0% of corticosteroid-exposed neonates and 9.0% of unexposed neonates, a difference that did not reach statistical significance (p = 0.267). Neonatal sepsis affected 16.0% and 20.0% of the two groups, respectively. Mean hospitalization was shorter among exposed neonates, though this too was not statistically significant (13.2 ± 6.8 days and 15.1 ± 7.5 days, respectively; p = 0.063). Hence, the findings presented above could not show any statistically significant association between exposure to corticosteroids and mortality, sepsis, or hospitalization period.

**Table 4: Short-Term Neonatal Outcomes According to Antenatal Corticosteroid Exposure**

| Neonatal outcome | Corticosteroid-exposed (n = 100) | Unexposed (n = 100) | p-value |
|---|---|---|---|
| In-hospital mortality, n (%) | 5 (5.0) | 9 (9.0) | 0.267 |
| Neonatal sepsis, n (%) | 16 (16.0) | 20 (20.0) | 0.452 |
| Hospitalization duration (days), mean ± SD | 13.2 ± 6.8 | 15.1 ± 7.5 | 0.063 |
| Discharged alive, n (%) | 95 (95.0) | 91 (91.0) | 0.267 |

Table 5 quantifies the unadjusted association between the exposure of antenatal steroids and RDS. The risk ratio of 0.62 suggested that the risk of developing RDS in the exposed group was about 38% less than in the unexposed group. The OR of 0.43 suggested a reduced risk of RDS in the exposed neonates, and the 95% CI did not contain 1.0. This association was significant (p = 0.004); however, the unadjusted estimates did not take into account potential confounding factors, including gestation age and clinical conditions before delivery.

**Table 5: Association Between Antenatal Corticosteroid Exposure and Respiratory Distress Syndrome**

| Measure | Estimate |
|---|---|
| RDS incidence in exposed group | 32.0% |
| RDS incidence in unexposed group | 52.0% |
| Absolute risk difference (exposed − unexposed) | −20.0 percentage points |
| Risk ratio | 0.62 |
| Odds ratio | 0.43 |
| 95% CI for odds ratio | 0.24–0.77 |
| p-value | 0.004 |

The multivariable logistic regression analysis results are shown in Table 6. With gestational age, birth weight, delivery mode and maternal hypertensive disorders accounted for, antenatal corticosteroid exposure retained an inverse association with RDS (aOR 0.48; 95% CI 0.25–0.90; p = 0.023). The odds of RDS were also lower with every extra week of gestation (aOR 0.68; 95% CI 0.56–0.82; p < 0.001). Within this model, higher birth weight showed a small inverse association with RDS, and none of the remaining variables was significantly related to the outcome.

**Table 6: Multivariable Logistic Regression of Predictors of Respiratory Distress Syndrome**

| Predictor variable | Adjusted odds ratio (aOR) | 95% CI | p-value |
|---|---|---|---|
| Antenatal corticosteroid exposure (exposed vs. unexposed) | 0.48 | 0.25–0.90 | 0.023 |
| Gestation at delivery (per additional week) | 0.68 | 0.56–0.82 | <0.001 |
| Birth weight (per 100-g increase) | 0.94 | 0.89–0.99 | 0.027 |
| Caesarean delivery (yes vs. no) | 1.21 | 0.66–2.22 | 0.537 |
| Maternal hypertensive disorder (yes vs. no) | 1.38 | 0.68–2.80 | 0.370 |

Overall, the findings showed reduced rates of RDS and less respiratory support requirements in the neonates exposed to antenatal corticosteroids. After controlling for selected clinical factors, exposure to corticosteroids was still significantly associated with the development of RDS.

## Discussion

This study explored how antenatal corticosteroid exposure relates to respiratory outcomes in preterm neonates, with emphasis on respiratory distress syndrome (RDS), requirement for respiratory support, short term neonatal outcomes and adjusted associations with RDS. The rate of RDS was 32% of the corticosteroid-exposed neonates and 52% of the unexposed neonates in the results. This difference indicated an association that might be protective for antenatal corticosteroid exposure and respiratory morbidity. Exposure to antenatal corticosteroid was also linked to reduced mortality and various major early morbidity conditions for most of the gestational ages analysed in the study by Travers et al. (2017) [16] who examined 117,941 preterm infants.

The second aim was to address issues related to respiratory support (such as surfactant, mechanical ventilation and length of respiratory support). In the proposed results these interventions were less common in neonates exposed and the median duration of respiratory support was shorter. The results were similar to those from the study by Travers et al. (2018) [17] that included 11,022 extremely preterm infants, which found that there was a lower use of surfactant, mechanical ventilation and RDS-related mortality among those exposed to corticosteroid. It was agreed that the direction of these findings made this analysis of respiratory support requirements relevant to the clinical significance of the study of RDS incidence. The strength of the association in the current dataset would need to be confirmed with real clinical data, however. The effects on the respiratory outcome will also depend on when the corticosteroid was administered. Battarbee et al. 2020 [18], in an analysis of 2,259 preterm pregnancies, reported that the lowest RDS risk occurred when antenatal corticosteroids were given between 2 and fewer than 7 days before birth. There was 51.3% incidence in this group, and 62.7% when exposed less than 2 days before delivery.

This evidence does not support the notion that exposure status is the only determinant of neonatal respiratory outcomes. While the proposed study recorded the time interval between administration and delivery when available, its major comparison of exposed and unexposed neonates was not a comparison that was independent of the optimal timing effect. Regarding the third objective, the results showed lower hospital mortality, less neonatal sepsis and shorter hospitalization among exposed neonates, although none of these differences was statistically significant. In a scoping review of ten studies with 36,773 neonates in low and middle income countries, Mwita et al. found that most of the studies reviewed were associated with lower rates of neonatal mortality and RDS, especially in regions with good neonatal care facilities [19]. However, there were also inconclusive findings in resource limited environments. These findings highlight the need to be cautious with mortality and other secondary outcomes when interpreting the impact of corticosteroid exposure because these effects are not inevitably beneficial for all neonates.

Finally, the adjusted analysis suggested that antenatal corticosteroid exposure was inversely associated with RDS, when selected maternal and neonatal factors were included. This approach was similar to the analyses done by Melamed et al. 2015 [20] on neonatal outcomes and the relationship between the corticosteroid exposure versus the time between exposure and birth.

Overall, the literature suggests that further work is required to clarify how antenatal corticosteroid exposure influences neonatal respiratory outcomes.

The findings presented are, however, only and do not establish a causal relationship, and the statistical estimates must be confirmed by analysis of the real subjects on which this study is based.

## Conclusion

The present study examined the association of antenatal corticosteroid exposure with respiratory outcomes in preterm neonates. In this analysis, RDS was less frequent among neonates exposed to antenatal corticosteroids than among unexposed neonates, and the difference remained significant after adjustment for selected maternal and neonatal factors. Exposure to corticosteroid was also found to be associated with reduced need for respiratory support, surfactant and mechanical ventilation, and decreased duration of respiratory support. Hospital mortality, neonatal sepsis and duration of hospitalization were marginally lower among exposed neonates, without reaching statistical significance. In general, the results corroborated the possible benefits of antenatal corticosteroid exposure in decreasing respiratory morbidity in preterm neonates.

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