Original Article

The Relation between the Timing of Electives, Emergency Cesarean Deliveries, and Early Neonatal Respiratory Morbidity in Neonates at Two Hospitals in Kirkuk City

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Abstract

Background: More than 21% of births worldwide are by cesarean section (CS). CS can save lives, but it increases the risk of neonatal respiratory morbidity, especially before 39 weeks. Preterm elective CS has been linked to higher newborn respiratory distress rates. Understanding these risks is essential for optimizing CS timing to improve neonatal outcomes. **Patients and Methods:** This study employed a hospital-based descriptive cross-sectional design conducted at two hospitals in Kirkuk City, Iraq, between December 2023 and February 2024. The study included 230 mothers who delivered infants between 36 and 41 weeks of gestation via elective or emergency CS or vaginal delivery. Data were collected using a structured questionnaire covering maternal medical history, gestational age, mode of delivery, and neonatal respiratory outcomes. **Results:** The study found that 14.8% of neonates developed respiratory distress syndrome (RDS), and 2/3 of them experienced transient tachypnea of the newborn. Infants delivered before 37 weeks were three times more likely to develop RDS than those delivered at or after 37 weeks (odds ratio = 3.1 and $P = 0.003$). Elective CSs were associated with lower respiratory morbidity compared to emergency CSs. In addition, advanced maternal age was significantly linked to higher rates of neonatal respiratory distress ($P = 0.046$). **Conclusion:** Delaying elective CSs until 39 weeks significantly reduces the risk of neonatal respiratory distress. Infants born before 39 weeks face a higher likelihood of RDS.

Keywords: Cesarean deliveries, electives, emergency, neonatal respiratory morbidity

Introduction

The prevalence of cesarean sections (CSs) worldwide has been steadily increasing, reaching over 21 percent of all births globally.[1,2] Although CSs are necessary in certain medical situations to save lives, the alarming increase in cesarean rates is due to its connection with substantial immediate and long-term health problems for both mothers and newborns.[3] According to published literature, elective cesarean birth is linked to a significant increase in the risk of respiratory problems in newborns, such as transient tachypnea, respiratory distress syndrome (RDS), persistent pulmonary hypertension, and the need for admission to the neonatal intensive care unit (NICU). This increase in risk ranges from two to almost seven times higher compared to vaginal birth.[4,5]

Prospective extensive multicenter studies consistently show that the severity of this health problem increases when a CS is performed before 39 weeks of gestation.[6] Consequently, most reputable international organizations advise against routinely doing elective CSs before 39 weeks in straightforward pregnancies with a single fetus.[7-9] Nevertheless, a significant number of CSs are being conducted globally for various causes before 39 weeks of gestation. The newborn outcomes of CSs performed during 37 + 0–38 + 6 weeks of gestation are currently being extensively studied in various regions worldwide.[10]

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Respiratory distress remains a significant problem postadaptation and one of the most common reasons for the admission of neonates to intensive care.[11] In Iraq, the neonatal period was in the early stages. The risk of respiratory distress was significantly higher in neonates delivered by elective cesarean birth than vaginal delivery. The rate of respiratory distress rose as the gestational age decreased for both groups. The duration of hospitalization decreased as gestational age increased.[12] The death rate in the NICU/Children Welfare Teaching Hospital is still high despite improving respiratory care and using invasive and noninvasive respiratory support. Approximately 2%–3% of all births are affected by RDS, although it accounts for around 50% of neonatal deaths.[13] The occurrence of RDS in premature newborns was 3.5 times higher compared to full-term newborns and 2.0 times higher in small-for-gestational-age newborns compared to appropriate-for-gestational-age newborns. Research revealed that individuals with air leaks were 11 times more likely to experience death from RDS compared to those without air leaks. Similarly, individuals with pneumonia were 4.0 times more likely to face death from RDS compared to those without pneumonia. The mortality rate for newborns delivered by elective CS was 2.4 times higher compared to those born by emergency CS. In addition, newborns of diabetic mothers had a mortality rate that was 5.1 times higher than those without diabetes.[14]

Hence, understanding the relationship between the timing of elective and emergency CSs and neonatal respiratory morbidity is crucial for informed decision-making in obstetric practice for obstetricians, expectant parents, and policymakers. For that, this study aims to determine the association between the timing of elective and emergency CSs and early neonatal respiratory morbidity in neonates and identify factors and variables that may influence this association.

Patients and Methods

This descriptive cross-sectional study was conducted at two hospitals in the neonatal care unit of Kirkuk City, Iraq: the Pediatric and Gynecology Hospital and the Azadi Teaching Hospital in Kirkuk City, Iraq. The data were collected from December 2023 to the end of February 2024. The Ethical Scientific Committee at the Department of Community and Family Medicine/College of Medicine/University of Baghdad provided official agreements, and the College Council of the College of Medicine granted their approval. After explaining the study's objectives and guaranteeing confidentiality, each mother provided verbal consent. Official agreements were also obtained from hospitals.

Infants with 36–41 gestational weeks born via elective or emergency CS or vaginal delivery were included in this study. Infants outside 36–41 gestational weeks with congenital malformations or infection, including pneumonia or meconium aspiration syndrome, were excluded from the study.

This study involved participants selected by convenient sampling at neonatal care unit for infants 36-41 gestational weeks born via elective or emergency CS or vaginal delivery. Questionnaire were developed after reviewing previous studies and literature. The questionnaire was collected The data were collected on the indications of elective or emergency CSs or vaginal delivery, factors such as maternal health, gestational age, and prenatal care, medical history of the mother, birth weight, gender, neonatal respiratory morbidity outcomes which included transient tachypnea of the newborn (TTN), RDS, and included others therapeutic measures which included: type of respiratory support required (O2, assisted ventilation

Microsoft Excel version 22 and IBM (SPSS) version 26 (SPSS Inc., Chicago, IL, USA.) were used in data processing and analysis. Continuous variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. The Chi-square and Fisher's exact tests were used to test the association between categorical variables, and an independent *t*-test was used to test the differences between means. $P < 0.05$ was considered statistically significant.

Results

Two hundred and thirty women participated in this study. Table 1 illustrates the sociodemographic descriptive statistics. Most of the women in the study were aged between 26 and 35 years, with 110 women (47.8%) falling into this age category. Regarding educational background, 111 women (48.3%) completed secondary school, and most of the women were homemakers, totaling 150 (65.2%); in terms of residence, the majority lived in urban areas, with 191 women (83.0%) [Table 1].

Most of the women (64.8%) had been pregnant three or more times (gravida ≥3). In terms of parity, 62.2% of the women had fewer than three births (para <3), with the remaining (37.8%)

Table 1: Sociodemographic characteristics among studied women in hospital neonatal units (*n*=230) in Kirkuk 2023–2024

Variables	*n* (%)
Educational background	
Illiterate	3 (1.3)
Read and write	2 (0.9)
Primary school	48 (20.9)
Secondary school	111 (48.3)
College and higher	66 (28.7)
Occupation	
Homemaker	150 (65.2)
Employed	64 (27.8)
Student	16 (7.0)
Residence	
Urban	191 (83.0)
Rural	39 (17.0)

having three or more births (para ≥3). Regarding abortion history, 27.4% had one or more abortions (abortion ≥1). Most pregnancies were singleton (220 women, 95.7%), with only 10 women (4.3%) having twin pregnancies. Regarding antenatal care, 127 women (55.2%) had 2–6 visits, 88 women (38.3%) had seven or more visits, and 15 women (6.5%) had fewer than two visits. A majority (172 women, 74.8%) did not have any chronic medical conditions, while 30 women (13.0%) had diabetes mellitus, 12 (5.2%) had hypertension, 3 (1.3%) had asthma, and 13 (5.7%) had other conditions like autoimmune diseases.

During their last pregnancy and labor, 151 women (65.7%) did not experience complications, whereas others reported gestational hypertension (31 women, 13.4%), leaking liquor (19 women, 8.3%), gestational diabetes (16 women, 6.9%), delayed labor (9 women, 3.9%), and preeclampsia (4 women, 1.7%). Active smoking was rare, with only 5 women (2.2%) reporting it, while 57 women (24.6%) were exposed to passive smoking. Steroid administration was almost evenly split, with 117 women (50.9%) receiving steroids and 113 women (49.1%) not receiving them.

The average gestational age at delivery among the studied patients was 37.9 ± 1.4 weeks, ranging from 36 to 41 weeks. Regarding the mode of delivery, 119 women (51.7%) underwent elective CSs, 71 women (30.9%) had emergency CSs, and 46 women (17.4%) had vaginal deliveries. For elective CSs, the primary indication was a previous CS (84 women, 70.6%), followed by fetal malpresentation (26 women, 21.9%) and maternal request (9 women, 7.5%). Emergency CSs were primarily due to fetal distress (49 women, 69.0%), cephalopelvic disproportion (12 women, 16.9%), placental abruption (7 women, 9.9%), and umbilical cord prolapse (3 women, 4.2%). In terms of anesthesia type, general anesthesia was administered to 120 women (63.2%), while 70 women (36.8%) received regional anesthesia [Table 2].

The neonates in the study had an average birth weight of 3.1 ± 0.5 kg, with weights ranging from 2.3 to 4.4 kg. Among the 230 neonates, 138 (60.0%) were male, and 92 (40.0%) were female. RDS was present in 34 neonates (14.8%), while the majority, 196 (85.2%), did not experience RDS. TTN was observed in 161 neonates (70.0%), whereas only 69 neonates (30.0%) did not have TTN. Notably, most neonates (200, 87.0%) required supplemental oxygen. However, the need for mechanical ventilation was much lower, with only 32 neonates (13.9%) requiring it, while 198 neonates (86.1%) did not. These data indicate a high prevalence of TTN and the universal need for supplemental oxygen among the neonates, reflecting significant respiratory challenges in this population.

Table 3 compares demographic and delivery-related parameters between neonates without respiratory distress (196) and those with respiratory distress (34). Maternal age shows a significant association, with a higher proportion of mothers aged ≥36 years in the respiratory distress group (35.3%) compared to those without respiratory distress (15.3%) (P = 0.046). Steroid administration before delivery did not significantly differ between the two groups (P = 0.630).

Type of CS was significantly associated with the presence or absence of RDS, with elective CSs being slightly more common among those without respiratory distress (49.5%) than those with it (47.0%) (P = 0.014). Emergency CSs were more common in the respiratory distress group (35.3% vs. 30.1%). Vaginal delivery was slightly more frequent in the no respiratory distress group (20.4% vs. 17.7%).

For elective CSs, previous CSs were a more common indication among those with respiratory distress (90.9%), although this difference was not statistically significant (P = 0.060). Indications for emergency CSs, such as fetal distress, cephalopelvic disproportion, placental abruption, and umbilical cord prolapse, did not show significant association (P = 0.435). Respiratory distress had no statistically significant association with gender.

Among the 34 neonates with RDS, 21 (61.8%) were born at or before 36 + 6 weeks of gestation, whereas 13 (38.2%) were born after 37 weeks. Conversely, of the 196 neonates without RDS, 67 (34.1%) were born at or before 37 weeks, and 129 (65.8%) were born after 37 weeks. The odds ratio (OR) of 3.1 (95% CI: 1.5–6.6) indicates that neonates born at or before 37 weeks are approximately three times more likely to develop RDS than those born after 37 weeks. P =0.003, derived from the Chi-square test, suggests that this difference is statistically significant, indicating a strong association between earlier gestational age and the occurrence of RDS.

Table 2: Delivery characteristics among studied patients (n=230) in Kirkuk 2023–2024

Variables	Total=230, *n* (%)
Gestational age at delivery (weeks), mean±SD (range)	37.9±1.4 (36–41)
Gestational age categories (weeks)	
<37	88 (38.2)
≥37	142 (61.8)
Mode of delivery	
Elective CS	119 (51.7)
Emergency CS	71 (30.9)
Vaginal delivery	40 (17.4)
Indications for elective CS	
Maternal request	9 (7.5)
Fetal malpresentation	26 (21.9)
Previous CS	84 (70.6)
Indications for emergency CS	
Fetal distress	49 (69.0)
Cephalopelvic disproportion	12 (16.9)
Placental abruption	7 (9.9)
Umbilical cord prolapses	3 (4.2)
Type of anesthesia	
General anesthesia	120 (63.2)
Regional anesthesia	70 (36.8)

CS: Cesarean section, SD: Standard deviation

Table 3: The association between demographic characteristics of maternal and neonatal participants and type of cesarean section with or without respiratory distress

Characteristic	With respiratory distress (*n*=34), *n* (%)	No respiratory distress (*n*=196), *n* (%)	*P**
Maternal age (years)			
<18	0	4 (2.0)	0.046
18–25	3 (8.8)	71 (36.2)	
26–35	19 (55.8)	91 (46.4)	
≥36	12 (35.3)	30 (15.3)	
Maternal steroid administration			
No	18 (52.9)	95 (48.5)	0.630
Yes	16 (47.1)	101 (51.5)	
Mode of delivery			
Elective CS	16 (47.0)	103 (49.5)	0.014
Emergency CS	12 (35.3)	59 (30.1)	
Normal vaginal delivery	6 (17.7)	34 (20.4)	
Indications for elective CS			
Maternal request	0	9 (9.3)	0.060
Fetal malpresentation	2 (9.1)	24 (24.7)	
Previous CS	20 (90.9)	64 (66.0)	
Indications for emergency CS			
Fetal distress	7 (49.9)	42 (69.5)	0.435
Cephalopelvic disproportion	2 (16.7)	10 (16.9)	
Placental abruption	2 (16.7)	5 (8.4)	
Umbilical cord prolapses	2 (16.7)	1 (5.1)	
Chronic medical condition of the mother			
None	22 (64.7)	150 (76.5)	0.472
Complications during the last pregnancy and labor			
None	23 (67.7)	128 (65.3)	0.268
Baby gender			
Male	25 (73.5)	113 (57.6)	0.081
Female	9 (26.5)	83 (42.3)	

*Chi-square test was used. CS: Cesarean section

Among the 161 newborns with TTN, 34.8% were born before 37 weeks, while 65.2% were born at or after 37 weeks. In contrast, among the 69 newborns without TTN, a higher percentage (46.4%) were born before 37 weeks, and 53.6% were born at or after 37 weeks. The OR (0.6) suggests that the likelihood of developing TTN is lower in newborns delivered before 37 weeks than those delivered at or after 37 weeks. However, this association is not statistically significant (P = 0.097). The confidence interval (0.3–1.1) further indicates that the result is not definitive, as it crosses 1.

For TTN, the prevalence was high across all GA groups: 33 out of 37 neonates (89.1%) at 36–36 + 6 weeks, 40 out of 51 (78.4%) at 37–37 + 6 weeks, 63 out of 73 (86.3%) at 38–38 + 6 weeks, 29 out of 32 (90.6%) at 39–39 + 6 weeks, and 33 out of 37 (89.2%) at 40–41 + 6 weeks. Despite the high prevalence, the differences were not statistically significant (P = 0.080).

For RDS, the rates varied more notably across GA groups. RDS was present in 6 out of 37 neonates (16.2%) at 36–36 + 6 weeks, 15 out of 51 (29.4%) at 37–37 + 6 weeks, 10 out of 73 (13.7%) at 38–38 + 6 weeks, 3 out of 32 (9.3%) at 39–39 + 6 weeks, and no cases at 40–41 + 6 weeks. These differences were statistically significant (P = 0.007), indicating a higher risk of RDS in neonates delivered by CS at earlier gestational age.

Discussion

One of the primary obstacles a newborn must overcome following birth is the successful shift to breathing air. The difficulty of this endeavor arises from fluid in the fetal lung, which must be swiftly evacuated to facilitate gas exchange. Failure to remove the fluid in the lungs of the fetus leads to respiratory problems, especially in infants delivered by CS.[15] The frequency of CS deliveries has risen during the last three decades due to various factors, including changes in breech management, previous CS, maternal medical conditions, fetal complications, and maternal desire.[16,17] The timing of CSs, both elective and emergency, is a critical factor in determining neonatal outcomes, particularly respiratory morbidity.

The timing of delivery, specifically gestational age, plays a crucial role in neonatal respiratory outcomes. In this study, neonates delivered before 37 weeks were three times more likely to develop RDS than those born at or after 37 weeks. This finding aligns with previous research that has consistently

shown increased risks of respiratory morbidity in neonates delivered before full term.[18]

Hansen *et al*.[19] conducted a cohort study that reported a significantly higher risk of respiratory complications in newborns delivered before 39 weeks, especially those between 37 and 38 weeks. Similar results were also found in the study by Rohilla *et al*.,[20] emphasizing the importance of postponing elective CSs until at least 39 weeks if possible. In addition, a survey by Zanardo *et al*.[21] revealed that CSs performed before 39 weeks are associated with a higher incidence of respiratory issues such as RDS and TTN.

The findings carry significant implications. Obstetricians need to carefully consider the risks of early delivery in comparison to the potential benefits, especially when nonmedical reasons lead to the consideration of elective CSs. The data indicate that the following guidelines for delivery after 39 weeks can notably decrease neonatal respiratory complications, leading to better outcomes for newborns and reducing the necessity for neonatal intensive care.

The study also examined the impact of delivery mode on the respiratory well-being of neonates, specifically comparing elective and emergency CSs. The results indicated that infants born through planned CSs often had somewhat improved respiratory outcomes compared to those born through unplanned CSs. More precisely, elective CSs were shown to be more commonly connected with the absence of respiratory distress. In contrast, emergency CSs were related to a greater incidence of respiratory distress.

The results align with the findings of Morrison *et al*.,[22] who observed that the date and manner of delivery, namely elective CSs performed at or before 39 weeks, significantly impact the respiratory outcomes of newborns. Rohilla *et al*.[20] emphasized that emergency CSs can lead to less-than-ideal respiratory outcomes because they lack the preparation techniques commonly used in planned surgeries.

The implications of this practice are clear: when a CS is necessary, careful planning and timing can significantly impact the newborn's outcomes. Elective CSs, when properly scheduled, can lower the risk of respiratory complications. However, in emergencies where the procedure cannot be postponed, healthcare providers must be ready to address potential respiratory issues more aggressively.

Steroid administration is a common intervention aimed at enhancing fetal lung maturity, particularly in cases where preterm birth is anticipated. In this study, the administration of steroids did not result in a statistically significant difference in respiratory outcomes between those who received steroids and those who did not ($P = 0.630$). This differs from several studies that have demonstrated the effectiveness of antenatal corticosteroids in reducing neonatal respiratory morbidity.

Gyamfi-Bannerman *et al*.[23] discovered that antenatal corticosteroids significantly decreased the occurrence of RDS and other respiratory issues in premature infants. The lack of significant numbers in this study could be due to various factors, such as variations in the timing of steroid administration, the specific corticosteroid used, or the population studied.

While this study did not provide statistically significant results, it is essential to recognize the major impact of steroids on enhancing fetal lung maturity. The time and amount of steroid administration are crucial parameters that might impact its effectiveness. Healthcare practitioners must follow recognized criteria for the use of corticosteroids in pregnancies that are at risk of preterm birth. In addition, they should consider individual patient variables that might impact the results.

Specific sociodemographic characteristics, such as the mother's age, education, and occupation, have been discovered to influence newborn outcomes. The study's findings suggest a correlation between advanced maternal age and higher respiratory distress in neonates. Moms who are 36 years or older are more likely to give birth to newborns with respiratory distress compared to younger moms.

The findings are consistent with previous research, suggesting that being an older mother is a risk factor for adverse outcomes in newborns, such as respiratory problems. Alterman *et al*.'s 2021 study in the UK[24] revealed that maternal age significantly predicted newborn outcomes. The study demonstrated that older moms were more prone to have delivery problems. Studies have demonstrated that a woman's educational attainment can influence the health outcomes of newborn babies. Mothers who have attained more significant levels of education have a reduced likelihood of having babies who experience respiratory distress. This may be attributed to their enhanced access to healthcare information and services. This association is consistent with the results of studies undertaken in other areas, such as the investigation by Horiuchi *et al*.[25] in Japan, which similarly discovered connections between maternal education and newborn health.

The results highlight the significant impact of sociodemographic variables on prenatal care. Adopting tailored healthcare approaches that consider the distinct needs of different demographic groups can significantly reduce respiratory disease rates and improve infants' overall well-being.

The study provides valuable insights into the relationship between the time and technique of cesarean births and the occurrence of respiratory morbidity in newborns. Nevertheless, it possesses specific constraints. The limited sample size may impede the identification of nuanced differences in outcomes across various groups. Moreover, the research was restricted to two hospitals in Kirkuk, Iraq, which may restrict the generalizability of the results to different populations or situations.

Various research in this domain have emphasized comparable constraints. Hansen *et al*. acknowledged that their study group was limited to a particular geographical region, which might affect the relevance of their findings.[19] In addition,

Morrison *et al*.[22] recognized the possibility of selection bias in their study, as it only included women who were scheduled for elective CSs. These commonly encountered limitations emphasize the need for more extensive and varied research efforts that can produce results with broader applications.

The findings of this study have substantial ramifications for clinical practice. It is essential to highlight the importance of the following recommendations: postpone elective cesarean procedures until the gestation reaches at least 39 weeks. This method can significantly reduce the likelihood of respiratory issues in infants, especially RDS. In addition, the results emphasize the significance of thoroughly evaluating the method of childbirth, with elective CSs being prioritized above emergency operations wherever possible.

These findings have important implications for public health policy. Enhancing national protocols about the scheduling of CSs is imperative, and healthcare professionals and pregnant women must be raised aware of the hazards linked to early-term births. Implementing public health campaigns might have a crucial impact on promoting these principles and ensuring uniform compliance across different healthcare settings.

Conclusion

In conclusion, the study confirms that delaying CS after 39 weeks of gestation is the best for infants. 14.6% of infants had RDS, while about two-thirds of them had TTN. It also concluded that infants <37 weeks of gestation are three times more likely to have RDS. A significant association was found between (maternal age mode of delivery) and infants' adverse respiratory morbidities.

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Conflicts of interest

There are no conflicts of interest.

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